# *TECHNICAL HANDBOOK*

# *DIGITAL INVERTERS*

# *FOXM SERIES*

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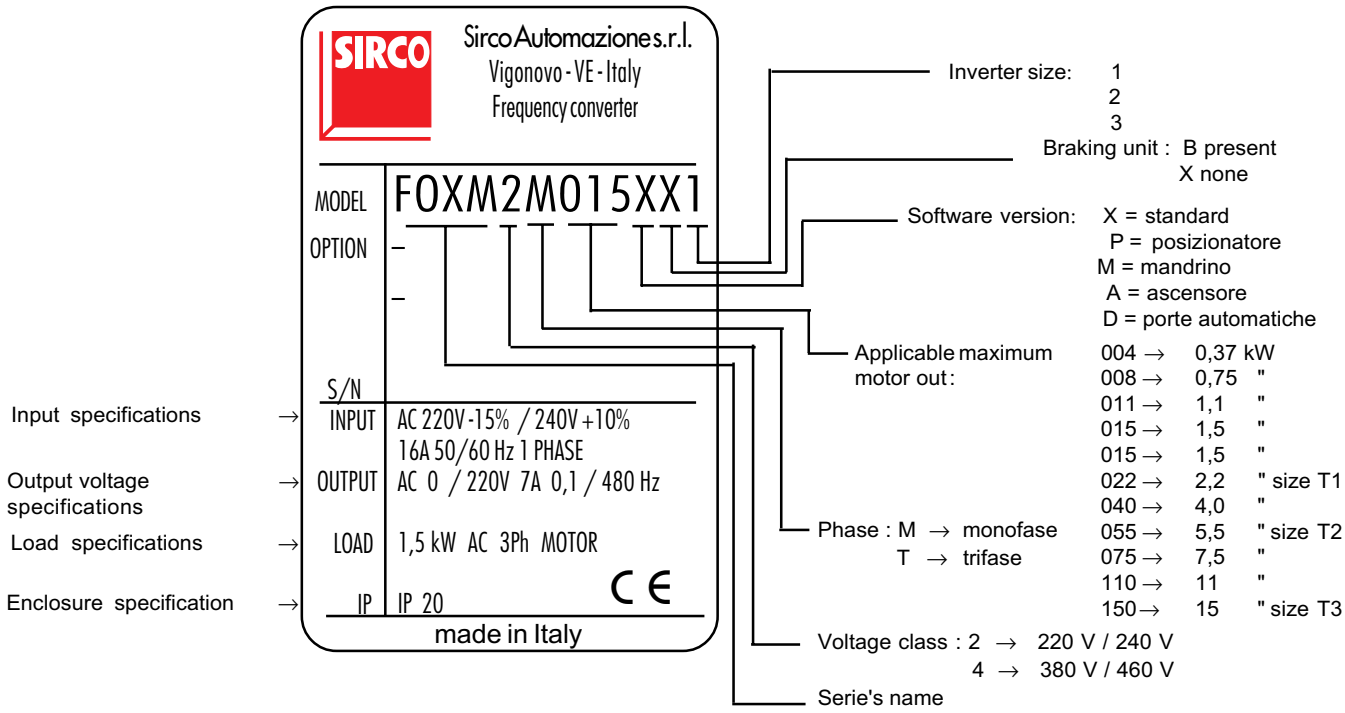
***NB:** This manual describe the function of the FOXM series.*

Reelease: 1.00
Software version: 00.01-06.03
Hardware version:
Edition: 24/06/03


SIRCO
Sirco Automazione s.r.l.
Vigonovo - VE - Italy
Frequency converter
MODEL
FOXM2M015XX1
OPTION
–
–
S/N
INPUT
AC 220V -15% / 240V +10%
16A 50/60 Hz 1 PHASE
OUTPUT
AC 0 / 220V 7A 0,1 / 480 Hz
LOAD
1,5 kW AC 3Ph MOTOR
IP
IP 20
CE
made in Italy
Input specifications
Output voltage specifications
Load specifications
Enclosure specification
Inverter size: 1 2 3
Braking unit : B present X none
Software version: X = standard P = posizionatore M = mandrino A = ascensore D = porte automatiche
Applicable maximum motor out:
004 → 0,37 kW
008 → 0,75 "
011 → 1,1 "
015 → 1,5 "
015 → 1,5 "
022 → 2,2 " size T1
040 → 4,0 "
055 → 5,5 " size T2
075 → 7,5 "
110 → 11 "
150 → 15 " size T3
Phase : M → monofase
T → trifase
Voltage class : 2 → 220 V / 240 V
4 → 380 V / 460 V
Serie's name

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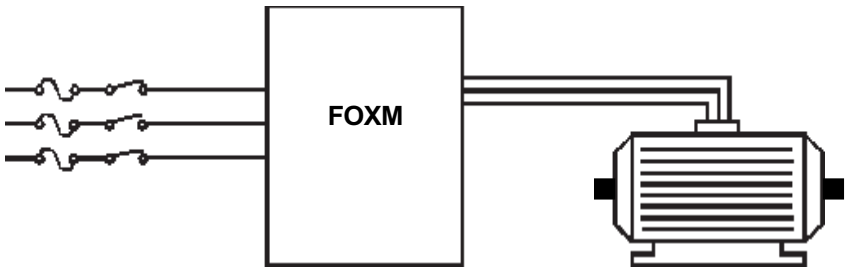
In spite of its compact dimensions, the **inverter FOXM** has several control features. When installed between mains and motor, the inverter will increase their performance by offering a long continuous service that will result in saving.




The main characteristic of the **FOXM inverter** is its efficient and flexible control of motor speed. In this way, the asynchronous motor can be used in a wider range of applications, with a more regular rotation and a significant reduction of noise compared to the older inverters.

The **FOXM inverter** can be used not only in the industrial field, e.g. machines, conveyor belts, etc., but also in the civil field where its good performance and noiseless operation are essential features for its use.

**- High torques at low revolution number**

The **FOXM inverter** produces high torques at low revolution number without discontinuity thanks to the automatism that, being activated from 0.1 Hz, assures a safe start of the motor .

**- Noise disappearance**

With the **FOXM inverter**, those annoying noises typical of the older inverters will never be heard. The noiseless operation of the inverter is due to a proper method of creating the waveform of the voltage that supplies the motor.

**- Continuity of operation in power failure state**

In case of temporary power failure, the **FOXM inverter** stops and starts again, and keeps the preset control characteristics without having to stop the motor.

**- Easy operation**

A panel consisting of four keys, one display with four 7-segment digits and three leds allows you to easily operate the **FOXM.**
The display and the keys allow you to change all the inverter parameters so as to make it suitable to all applications.
The display also shows the values controlled, e.g. frequency or current, and the error codes in case of improper operation.

A programming key device allows to copy the preset control characteristic of the inverter for transferring parameters from and to or between inverters.

Besides being controlled from panel, the **FOXM inverter** can be easily remote controlled and programmed through series connection by means of a proper communication protocol.
However, the run, stop, speed reversal and change operations are performed, as usual, through terminal board.

## General safety instructions

Throughout the text, the following **Danger symbols** indicate paragraphs containing particular instructions that must be carefully read so as to assure safety conditions to users:

⇒ This warns the user about the presence of a dangerous voltage. It indicates the presence of High Voltage conditions that can cause serious damages or even death.

⇒ This indicates a general danger or very important operation notes.

**Warnings**

- Electrical devices can represent a **risk source for personnel safety.** It is therefore necessary to know all usage methods and unit control devices perfectly before using the machine.

- The machine should then be used by skilled personnel only, aware of the installation and operation rules, in compliance with the safety and protection standards, and able to interpret all danger warnings.
  The capacitors contained in the machine have dangerous high voltages. After cutting power off, you should wait at least 5 minutes before performing any operation.
  With stopped motor, dangerous voltages can be present on the entire power terminal board:
  terminals **L1**, **L2**, **L3, U, V, W.**

- In particular adjustment programming conditions, after a power failure, the machine could start automatically.

**Warranty notes**

The warranty conditions are scheduled by the supplier at the moment drive purchased.
The supplier decline his responsibility from drive damaging during shipping or unpacking.

The unit is designed for motor speed control only. Do not use it for other applications.
The manufacturer is not responsible for damages deriving from improper use or installation or inadeguate ambient conditions, as well as for damages due to improper rated values.
Nor will, the manufacturer be responsible for consequential or accidental damages.

No intervention has to be perfomed on parts inside the machine: when installing, just remove the terminal board cover panel. Any tampering or use of spare parts or other parts not supplied by the manufacturer, besides making the warranty void, may cause damages and/or serious accidents.

Starting from drive startup its warronty period is 24 months or no more than 36 months (refer to the soles conditions agreed).

The technical data contained in this manual are to be considered correct at printout time. The manufacturer, however, reserves the right to change, without notice, both the contents and the technical data of the product.

The **FOXM...-M** inverters are converters with D.C. intermediate circuit. When connected with a common single or threephase mains, they produce a threephase, variable-frequency, A.C. voltage, used to control the speed of threephase asynchronous motors.

The control circuit has a microprocessor properly programmed.

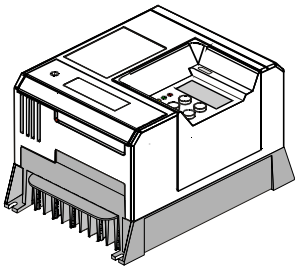
The control keyboard allows the user to easiliy and quickly enter any parameter necessary for the required working conditions.

The threephase, variable frequency, alternate voltage, controlled by microprocessor, is delivered to the motor through a power module which uses the most recent IGBT technology.
The use of microprocessor, IGBT technology and modulation frequency programming, assures an extremely accurate and silent operation.

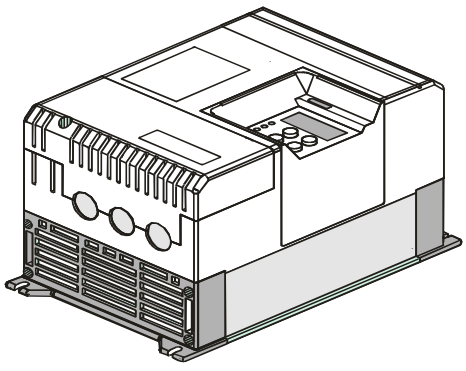
The software, properly developed for power electronics, allows for an accurate and quick control of motor speed, start and stop times which can be independently adjusted, and other operation conditions:

- Speed control as a function of the load is by current adjustment, thus allowing for automatic adjustment to process.
- Automatic boost that allows for a safe start of the motor by acting on the torque as a function of the load. Presence of high torques and rotation evenness at very low frequencies too.
- Direct current braking, with programmable duration and value, allowing for a comfortable motor stop.
- Presence of a PID-type inner regulator, which can be freely configured, to control the motor speed and/or torque.
- Presence of a standard series line, with programmable transmission modes, to remote program and/or control the converter.

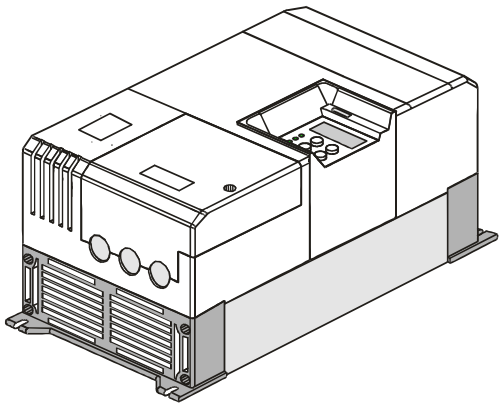
Further, the unit is provided with two programmable relay outputs and two programmable opto-insulated digital outputs, for alarms and machine state signalling. It also has an analog output that indicates, through selection, the trend of the main values of the inverter.



**FOXM Size 1**
**0,24 -2,2 Kw**
**380/460 V**
**3-phase**



**FOXM Size 2**
**5,5 Kw**
**380/460 V**
**3-phase**



**FOXM Size 3**
**15 Kw**
**380/460 V**
**3-phase**

**Guide to the choice**

| Inverter model | Input voltage | Inverter output | Rated output current | Corrente assorbita per fase | $P_N$ motor recomended | $P_V$ heat inverter dissipation | Min. value of external resistor | Size |
|---|---|---|---|---|---|---|---|---|
| | Vac | kVA | A | A | kW | W | Ohm | |
| **FOXM2M004** | 220 V - 15% 240 V + 10% 50 / 60 Hz single - phase | 1,0 | 2,2 | 4,5 | 0,37 | 25 | 100 | T1 |
| **FOXM2M008** | | 1,6 | 4,0 | 9,0 | 0,75 | 45 | 100 | |
| **FOXM2M011** | | 2,2 | 6,0 | 12,0 | 1,1 | 60 | 100 | |
| **FOXM2M015** | | 2,9 | 7,0 | 16,0 | 1,5 | 80 | 50 | |
| **FOXM2M022** | | 4,0 | 10,0 | 20,0 | 2,2 | 100 | 50 | |
| **FOXM2T004** | 220 V - 15% 240 V + 10% 50 / 60 Hz three - phase | 1,0 | 2,2 | 2,5 | 0,37 | 25 | 100 | |
| **FOXM2T008** | | 1,6 | 4,0 | 5,0 | 0,75 | 45 | 100 | |
| **FOXM2T011** | | 2,2 | 6,0 | 8,0 | 1,1 | 60 | 100 | |
| **FOXM2T015** | | 2,9 | 7,0 | 9,0 | 1,5 | 80 | 50 | |
| **FOXM2T022** | | 4,0 | 9,5 | 11,0 | 2,2 | 100 | 50 | |
| **FOXM4T004** | 380 V - 15% 460 V + 10% 50 / 60 Hz three - phase | 1,0 | 1,3 | 3,2 | 0,37 | 20 | 50 (*) | |
| **FOXM4T008** | | 1,6 | 2,2 | 3,5 | 0,75 | 30 | 50 (*) | |
| **FOXM4T011** | | 2,2 | 2,8 | 5,1 | 1,1 | 40 | 50 (*) | |
| **FOXM4T015** | | 2,9 | 4,0 | 6,0 | 1,5 | 50 | 50 (*) | |
| **FOXM4T022** | | 4,0 | 5,5 | 8,0 | 2,2 | 70 | 50 (*) | |
| **FOXM4T040** | | 6,8 | 9,0 | 13,0 | 4,0 | 160 | 50 | T2 |
| **FOXM4T055** | | 9,0 | 12,5 | 16,0 | 5,5 | 230 | 50 | |
| **FOXM4T075** | | 12,5 | 17,0 | 21,0 | 7,5 | 300 | 25 (**) | T3 |
| **FOXM4T110** | | 15,0 | 25,0 | 30,0 | 11,0 | 450 | 25 (**) | |
| **FOXM4T150** | | 25,7 | 35,0 | 40,5 | 15,0 | 630 | 25 (**) | |

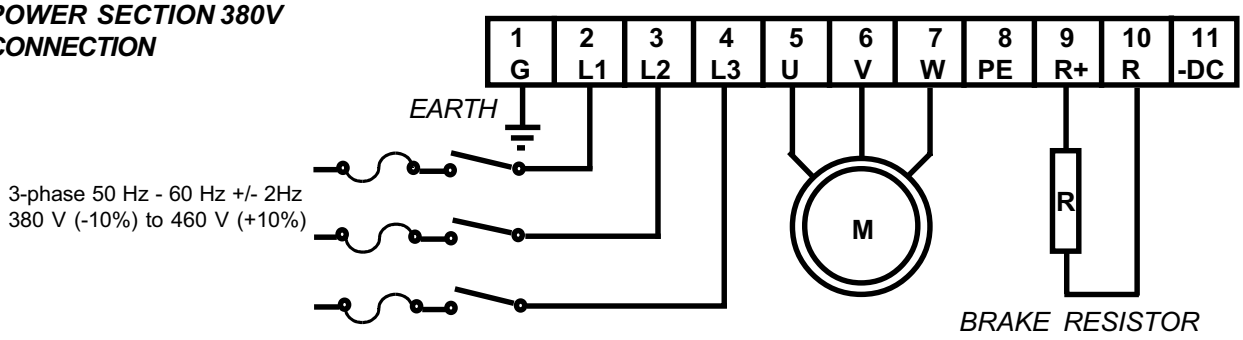
(*) resistor value suggested: 100 Ohm

(**) resistor value suggested: 50 Ohm

## Protection degree IP 20

<table>
<tr><td>Input voltage</td><td colspan="5">380/460 V, -15%, +10%, 3-phase<br>frequency: 47 Hz / 63 Hz.</td></tr>
<tr><td rowspan="4">Outputs</td><td>voltage</td><td colspan="4">3-phase from 0V to input voltage.</td></tr>
<tr><td>frequency</td><td colspan="4">output : from 0,1 to 500 Hz; resolution 0,1 Hz (0,01 Hz if set via serial line, or with optional 16 bit board).<br>switching : from 1kHz to 18 kHz, programmable.</td></tr>
<tr><td>current</td><td colspan="4">continuous output: nominal current of the inverter type .<br>overload capacity : to 200% for 30" every 20' (model dependent).</td></tr>
<tr><td>accel./decel.</td><td colspan="2">acceleration time: 0,01 to 9999 sec.<br>deceleration time: 0,01 to 9999 sec.<br>" S " characteristic: 0,0 to 10,0 sec.</td><td colspan="2">4 different types, of previous programmed acc./dec. times, can be externally selected.</td></tr>
<tr><td>Environment conditions</td><td colspan="5">operation temp.: 0°C to + 40°C (temperature close to the inverter);<br>storage temp.: -20°C a +60°C<br>ventilation: self cooling to 2,2 kW, then the ventilation is forced ;(free of oil, dust, or corrosive gas)<br>humidity: 20% RH to 90% RH, non-condensing.<br>installation: max. 2000 m sea level elevation. (over, the characteristics must be derated )</td></tr>
<tr><td rowspan="6">External controls</td><td rowspan="3">Inputs</td><td>Digital optoisolated NPN or PNP</td><td>Operation signals</td><td colspan="2">start ( forward run ), direction ( reverse run).<br>alarm external (the action is programmable).<br>5 other: selectable betwen:<br>alarm reset; frequency selector: F1, F2, F3; acc./dec. ramp selector: T1, T2; inverter enable; d.c. braking enable; start d.c. braking; flying restart ;</td></tr>
<tr><td>Line driver</td><td>Encoder</td><td colspan="2">(with optional card), accept 2 ch. from an encoder or a frequency signal to be used as a frequency refer. or speed feedback</td></tr>
<tr><td>Analog</td><td>Frequency reference</td><td colspan="2">1°)selectable : 0/10V or -10V/+10V or 0-20mA, offset and gain programmable.<br>2°)selectable : 0/20 mA or 4/20 mA.<br>3°)auxiliary: 0/10V, or +-10V or 0-20mA, offset and gain programmable, selectable function.</td></tr>
<tr><td rowspan="3">Outputs</td><td rowspan="3">Indications</td><td>Relays</td><td colspan="2">1°)alarm contact<br>2°)multifunction contact: state of the inverter, frequency, acc./dec. ramps, encoder etc.</td></tr>
<tr><td>Photocoupler outputs</td><td colspan="2">1°)open collector, selectable: same functions as relay n.2<br>2°) " " " " " "</td></tr>
<tr><td>Analog</td><td colspan="2">0/10V (8 bit standard) o -10/+10V(10 bit optional): gain and offset programmable;amplitude function of one of following signals: output freq. or voltage or current or torque and also cosφ or power.</td></tr>
<tr><td>Comunications</td><td colspan="2">RS-485</td><td colspan="2">2-wire operation: 32 inverter max. can be linked in parallel; transmission parameters are programmable; can be used to substitute the keypad panel.</td></tr>
<tr><td>Protection functions</td><td colspan="5">overcurrent, undervoltage (programmable threshold), overvoltage, inverter overheating; overload of: inverter, motor, braking resistor; phase loss (for three phase models ), inner fuse cutoff, phase to phase and phase to ground shortcircuit, value of stored parameter error.</td></tr>
<tr><td>Standard functions</td><td colspan="5">V/F characteristic programmable, slip compensation, autoreset (number of retries and base time programmable), jump frequency, upper and lower output frequency limits, flying restart, momentary power loss, PID control loop, motor stall or inverter fault prevention .</td></tr>
</table>

***POWER SECTION 380V CONNECTION***




## POWER CONNECTIONS

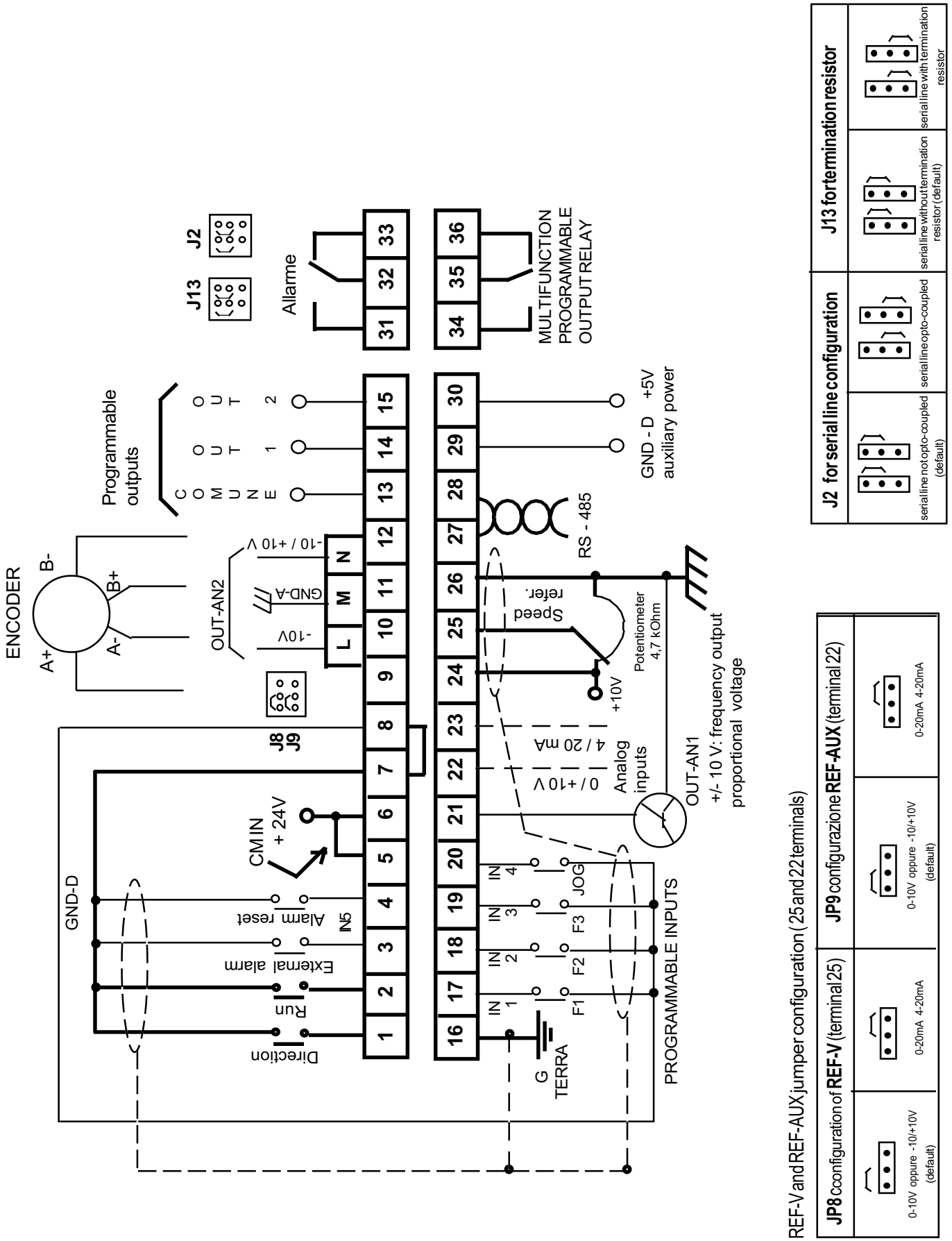
| TERMINALS | No. | FUNCTION |
|---|---|---|
| **G** | 1 | EARTH CONNECTION |
| **L1(L)** | 2 | MAINS SUPPLY |
| **L2(N)** | 3 | 220 V SINGLE PHASE OR THREE PHASE |
| **L3** | 4 | 460 V THREE-PHASE |
| **U** | 5 | THREE-PHASE OUTPUT |
| **V** | 6 | (TO THE MOTOR) |
| **W** | 7 | |
| **PE** | 8 | POWER EARTH |
| ⊕ | 9 | BRAKING RESISTOR |
| **R** | 10 | CONNECTIONS |
| ⊖ | 11 | NEGATIVE OF D.C. CIRCUIT |

| Inverter model | Input voltage | Line fuse recomended (slow-blow type) | Minimu section Supply cables and motor cables |
|---|---|---|---|
| | A | A | $mm^2$ |
| FOXM2M004XX1 | 4,5 | 10 | 1,5 |
| FOXM2M008XX1 | 9,0 | 16 | 1,5 |
| FOXM2M011XX1 | 12,0 | 20 | 3,0 |
| FOXM2M015XX1 | 16,0 | 25 | 4,0 |
| FOXM2M022XX1 | 20,0 | 25 | 4,0 |
| FOXM2T004XX1 | 2,5 | 6 | 1,5 |
| FOXM2T008XX1 | 5,0 | 10 | 1,5 |
| FOXM2T011XX1 | 8,0 | 16 | 1,5 |
| FOXM2T015XX1 | 9,0 | 16 | 2,5 |
| FOXM2T022XX1 | 11,0 | 16 | 2,5 |
| FOXM4T008XX1 | 3,5 | 10 | 1,5 |
| FOXM4T015XX1 | 6,0 | 10 | 1,5 |
| FOXM4T022XX1 | 8,0 | 16 | 1,5 |
| FOXM4T040XX2 | 13,0 | 25 | 2,5 |
| FOXM4T055XX2 | 16,0 | 25 | 4,0 |
| FOXM4T075XX3 | 21,0 | 32 | 4,0 |
| FOXM4T110XX3 | 30,0 | 44 | 6,0 |
| FOXM4T150XX3 | 41,0 | 44 | 8,0 |

If the system where the inverter is installed is provided with **overcurrent switch**, this one should be calibrated for a tripping **current not lower** than 100 mA and for a time not lower than 0,1 sec. Further, it must be able to support high frequency disturbance events.

Here, the cables section indicated is the lowest one required when the length does not exceed 30 m. In this way, the leakages are reduced and the voltage drop do not exceed 5% of the supply voltage, as specified in EN60204-1 standard.

**Control section**




| **J2 for serial line configuration** | | | **J13 for termination resistor** | |
|---|---|---|---|---|
| serial line not opto-coupled (default) | serial line opto-coupled | serial line without termination resistor (default) | serial line with termination resistor | |

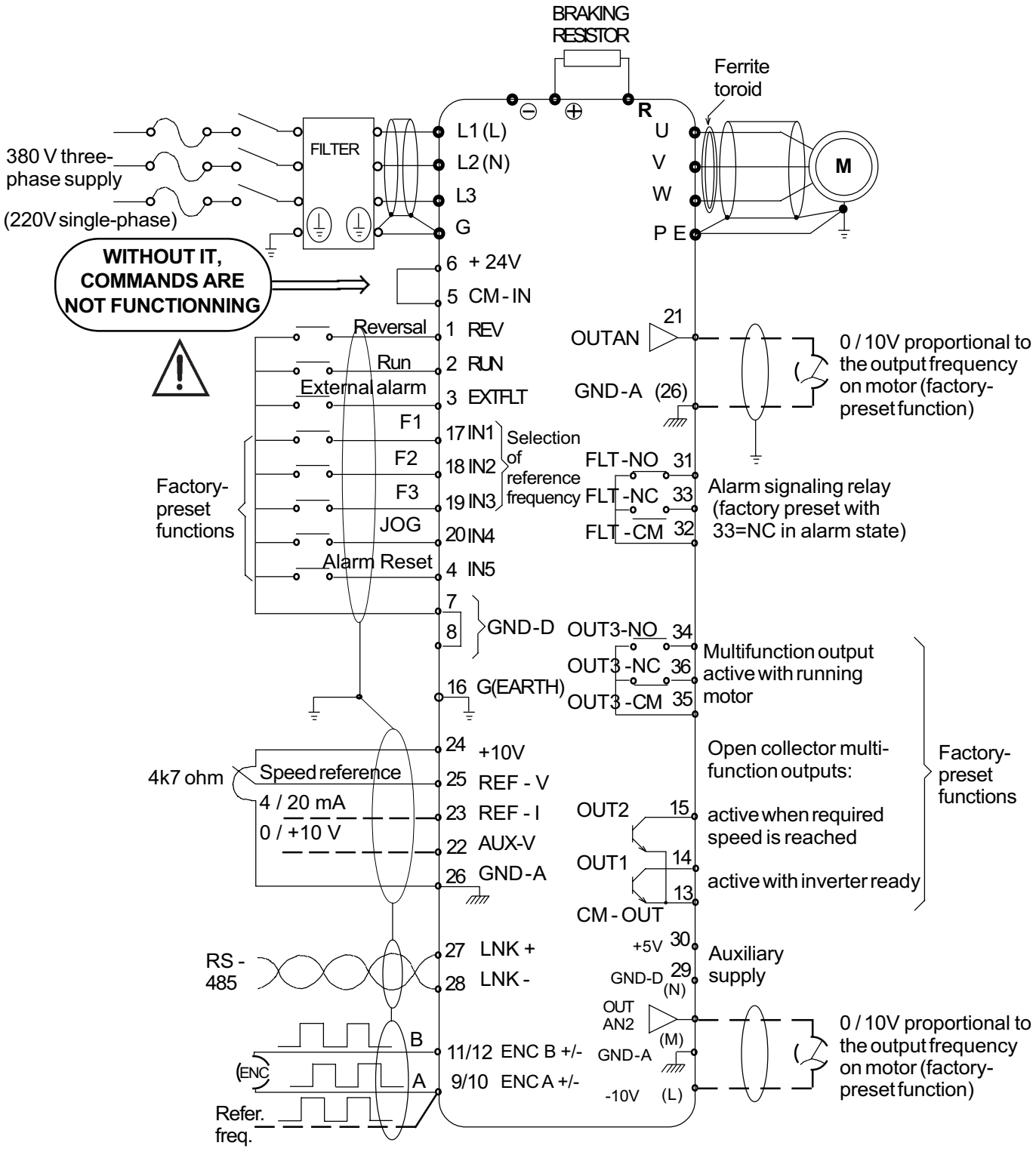
REF-V and REF-AUX jumper configuration (25 and 22 terminals)

| **JP8** configuration of **REF-V** (terminal 25) | | **JP9** configurazione **REF-AUX** (terminal 22) | |
|---|---|---|---|
| 0-10V oppure -10/+10V (default) | 0-20mA 4-20mA | 0-10V oppure -10/+10V (default) | 0-20mA 4-20mA |

## Control connections

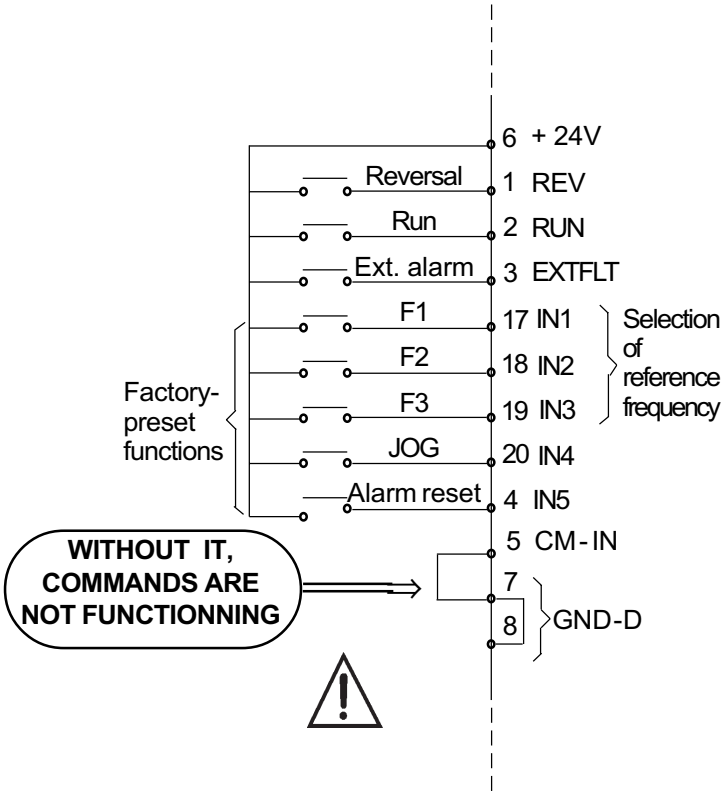
| TERMINALS | | FUNCTION | | | SIGNAL TYPE |
|---|---|---|---|---|---|
| REV | 1 | Reversal | If **b-00=1:** | Backward run | Optical couplers: 24 V, 6 mA |
| RUN | 2 | Run | | Forward run | |
| EXTFLT | 3 | Alarm from outside | | | |
| IN5 | 4 | Digital input, can be configured by: **P-43** | | | |
| CM-IN | 5 | Digital inputs common | | | |
| +24 V | 6 | Auxiliary supply for digital inputs | | | 24 V +/- 5% 300 mA |
| GND-D | 7 | Reference ground for digital inputs | | | |
| GND-D | 8 | | | | |
| ENC-A+ | 9 | Inputs from encoder channel A or from a frequency transducer | | | Option |
| ENC-A- | 10 | | | | |
| ENC-B+ | 11 | Inputs from encoder channel B | | | |
| ENC-B- | 12 | | | | |
| CM-OUT | 13 | Digital outputs common | | | Optical couplers: 50 V, 50 mA |
| OUT1 | 14 | Digital output, can be configured by: | | **P-44** | |
| OUT2 | 15 | | | **P-45** | |
| EARTH | 16 | Earth connections | | | |
| IN1 | 17 | Digital inputs, can be configured by: | | **P-39** | Optical couplers: 24 V, 6 mA |
| IN2 | 18 | | | **P-40** | |
| IN3 | 19 | | | **P-41** | |
| IN4 | 20 | | | **P-42** | |
| OUT-AN | 21 | Analog output, can be configured | | **P-48** | 0 - 10 V +/- 10V and 0-10mA Rload min.= 2 k |
| AUX-V | 22 | Analog input, can be configured | | **P-47** | 0 - 10 V Ri = 20 k |
| REF-I | 23 | Current reference input for speed control | | | 0 - 20 mA or 4 - 20 mA Ri = 250 Ohm 10 V |
| +10V | 24 | Potentiometer voltage for speed refer. | | | +/- 3% 50 mA |
| REF-V | 25 | Voltage reference input for speed control | | | 0 - 10 V or + - 10 V and 0-20mA Ri = 20 k |
| GND-A | 26 | Common for analog input/output circuit | | | |
| LNK+ | 27 | Inputs for serial line **RS-485** | | | |
| LNK- | 28 | | | | |
| GND-D | 29 | Auxiliary supply | | | 5 V +/- 5% 50 mA |
| +5V | 30 | | | | |
| FLT-NO | 31 | Alarm relay: | **Open during alarm** | | contact capacity: 250 Vac 0,2A<br>30 Vdc 1A |
| FLT-CM | 32 | | **Common** | | |
| FLT-NC | 33 | | **Closed during alarm** | | |
| OUT3-NO | 34 | Contacts of output relay, can be configured by: | | **P-46** | |
| OUT3-CM | 35 | | | | |
| OUT3-NC | 36 | | | | |
| - 10V | L | Voltage potential reference for analog input ref. | | | 10V +/-3% 50mA |
| GND-A | M | 0V potential reference for analog inputs/outputs | | | |
| OUT-AN2 | N | Analog output, can be configured 2 | | | 0-10V o +/-10V e 0-20mA Rload min. = 2K |

**Connections**

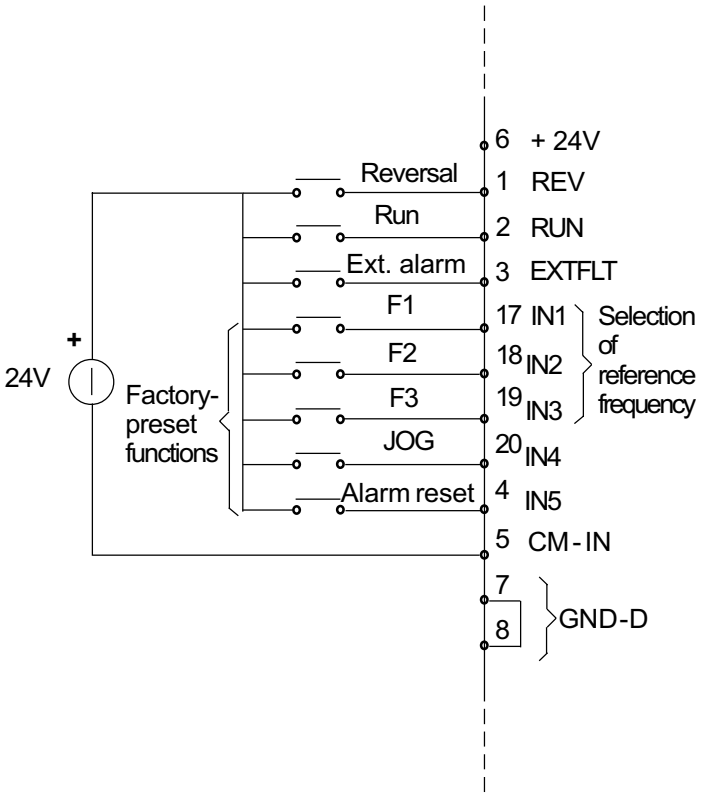



**NOTE:** The connections indicated for control keys are the most common solution for a NPN-type control. Other examples are given on the following page.

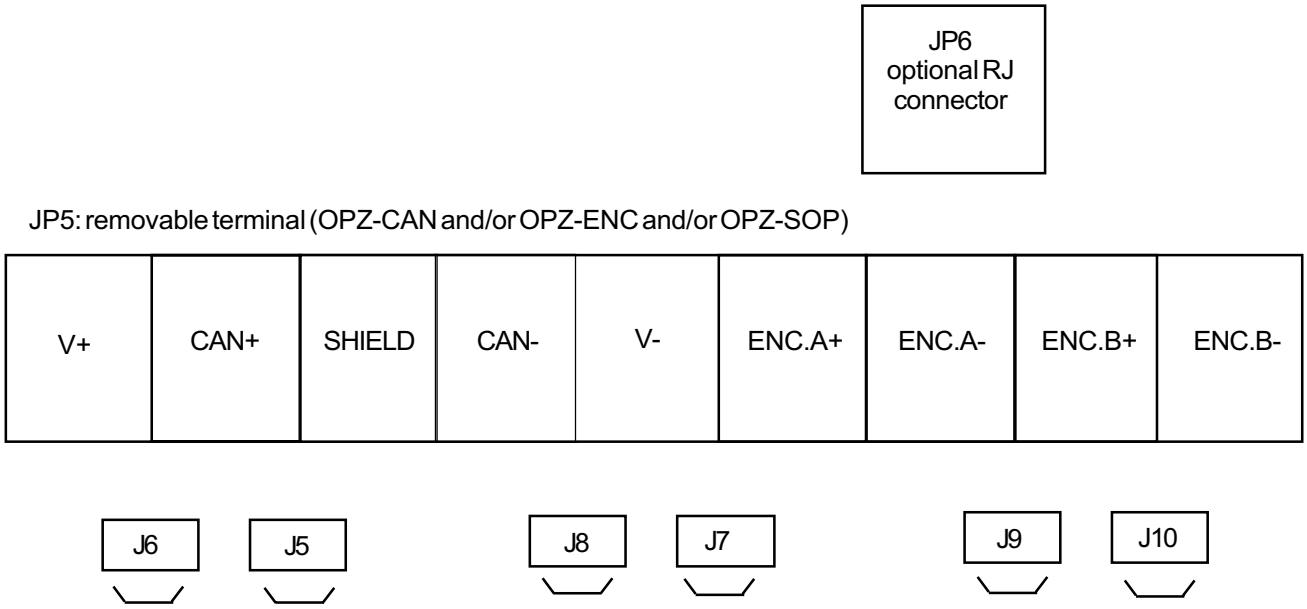
Connections for PNP-type controls:




Connections for controls opto-insulated from the inverter:



**OPTIONAL TERMINAL FEATURES**




Depending by customer request, the drive regulation board can be equipped with different optional configurations. The request must be present in the phase order.

OPTO-COUPLED SERIAL LINE (OPZ-SOP): refer to page 43 for details.

CANBUS PROTOCOL (OPZ-CAN): the power supply range of this circuit is 12-30V, so it can be applied on V+ and V- terminals, JP5 connector. CAN+, CAN- and SHIELD terminals are also available for CANOPEN and/or DEVICENET protocol.

ENCODER (OPZ-ENC): reading of encoder signal. JP5 connector is assigned as encoder input, defaulted to 24V logic level (J9 and J10 jumpers not inserted) . For 5V encoder logic level, J9 and J10 jumpers must be inserted.

OPTIONAL BOARDS (OPZ-ESE): through RJ JP6 connector it is possible to interface different optional boards, as PROFIBUS card.

## INSTALLATION GUIDELINES

In order to obtain a safe operation of the unit, assembly and start-up should be performed by skilled person nel only, according to the general regulations concerning safety conditions when working with high currents or voltages.

- **Mechanical installation**

Removal of the heat produced by the inverter is performed by ventilating with natural air flow, in low power models, and by means of fan in all other models.
When assembling, leave a space of at least 40 mm. from the sides and 150 mm. above and below the inverter, so as to assure a free circulation of the cooling air. In case of stacking of more units, leave a vertical space of at least 300 mm. between them.

The site should assure the ventilation air is free from dust or corrosive gases, otherwise a regular cleaning of the cooling surfaces must be performed. Avoid, in any case, the condensation of the sprayed fluids. The ambient humidity should never exceed 90%.

In working conditions, the temperature inside the cabinet should never exceed 40° C. If it should, it will be necessary to perform a derating of the unit or a forced ventilation so as to avoid air stagnation.

**Warning:** When calculating the overall dimensions, also consider the space required for installation of anti-noise filters.

- **Electrical installation**

The inverters are designed to operate in an industrial environment where high levels of electro-magnetic disturbance must be expected. Good installation practice usually ensure trouble-free operation, however it is suggested that a good earth connection and RFI filters should be used. The RFI filters ensure a reduction of radiated or conducted interference when the inverter is in a interference sensible environment.

To connect the inverter, just remove the cover which protects the power and control terminal boards.

The **FOXM** series is designed both for 380V / 460V three phase supply.

For supply cables, we recommend using two-wire (phase + neutral) shielded cable or four-wire (the three phases+earth) shielded cable, with the earth cable external but parallel to the shield; dimensionning must consider a $\Delta V$ on cable not more than 5% of mains voltage as per EN60204-1.

The same cable can be used for motor connection too. The cable length should never exceed 30 m. If it should, use additional inductances, series-connected with cables, to balance the parasitic capacities. In this case, a reduction of motor voltage can be noticed.

**Warning:** The inverter supply must be protected by means of fuses or automatic switch.

Make sure the cables are properly connected and, in particular, check that the earth connection is correctly locked. In case of shielded supply cables, connect the shield with the G(EARTH) terminal on drive and motor side.
The power cables must be kept separate from the signal cables. The standards require the use of separate raceways.
For control cables, use a shielded cable with a section of at least 0.5 $mm^2$. The shield should be connected with **PE** (0V, terminal 16) on drive side only.
For connection of reference signals or serial line, use twisted cables.
Connect spark quenching units in parallel to relay coils, solenoid valves, remote control switches located near the unit, as suggested on the following table:

| REMOTE CONTROL SWITCH OR SOLENOID VALVE TYPE | CHARACTERISTICS OF SPARK QUENCHING UNIT | |
|---|---|---|
| 380, 460 V | 0.5 uF + 100 Ohm 1/2 W | 1000 V |

**Warning:** The protection circuit failure towards earth must ONLY protect the inverter against failures towards earth, occurring on the motor cable or on the motor itself. It is NOT designed to protect people who accidentally touch the motor or the corresponding supplying cable.

**It is forbidden:** to connect PFC devices to output terminals between inverter and motor;
to connect capacitors between output terminals or output terminals and earth;

**It is not advisable:** to connect remote control switches to output terminals between inverter and motor.

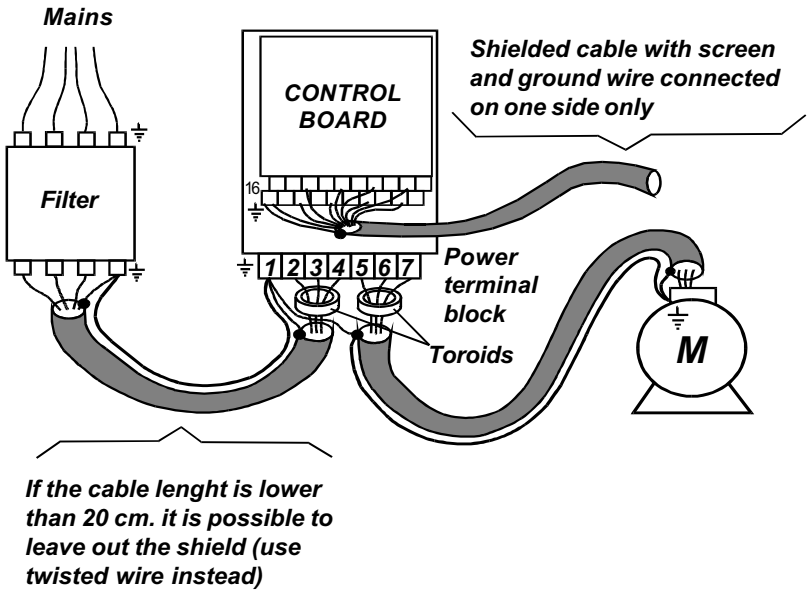
**Wiring hint**

**Note: To connect the inverter it is necessary to conform to the following indications:**

1 - Power supply wiring: only the three power wires must be shielded; the ground wire, **which is obligatory**, must be external to the shield and run parallel to it.
2 - Both the inverter side and the motor or filter side of the shield must be grounded.
3 - The ferrite toroid must be put on the inverter side of the cable in a way to cover the part of the cable uncovered from the shield.
4 - The power cables must be kept separated from the signal cables; it is forbidden to install power and signal cables in the same conduit or duct. It is important to hold motor wiring as far as possible from the power supply wiring.
5 - Use high quality motors, with low parasitic capacities towards ground.

The input filter increases leak currents towards ground; so it is advisable use a overcurrent switch with a tripping current not lower than 100 mA .

**The following drawing shows the wiring method wich is in compliance with the standards.**


Mains
CONTROL BOARD
Shielded cable with screen and ground wire connected on one side only
Filter
16
1 2 3 4 5 6 7
Power terminal block
Toroids
M
If the cable lenght is lower than 20 cm. it is possible to leave out the shield (use twisted wire instead)

**Operation**

**CAUTION** Before turning the inverter on, make sure the cover is locked in position. After each turning off, wait some minutes before opening the unit so as to allow the capacitors to discharge.
For safety reasons, at power on or after a reset due to an alarm, the inverter is factory-preset not to start even with run control in active state. To start the motor, you should set the control first to OFF and then to ON (this safety precaution can be intentionally cancelled through parameter **b-03**).

- **Turning on**

The inverter is not provided with a ON/OFF switch. This operation is performed by appliying the mains voltage. After voltage application, the inverter performs a test. If an error is encountered during this test, the display will show the message E. Err
The display, consisting of four 7-segment digits, shows both letters and numbers. When turned on, it shows the output frequency value ( 0.0 Hz with stopped motor).
The inverter is factory-preset to control standard motors which operate with voltages and currents having values corresponding to the inverter size.

- **Run**

1 - Connect a 4,7 kOhm potentiometer for speed reference (terminals 24, 25, 26).
2 - Connect two contacts for forward and backward run control (terminals 2, 1, and 7/8 ) as shown on page 9/10.
3 - Close the the run contact to start the motor . The motor is started at the frequency selected through the preset ramp (5 seconds from 0 Hz to maximum frequency).

**ATTENTION** If the factory - preset values should be modified to adapt the inverter to the application, it can be made through the control panel where the actual values can be displaied, then modified, and then permanently stored.

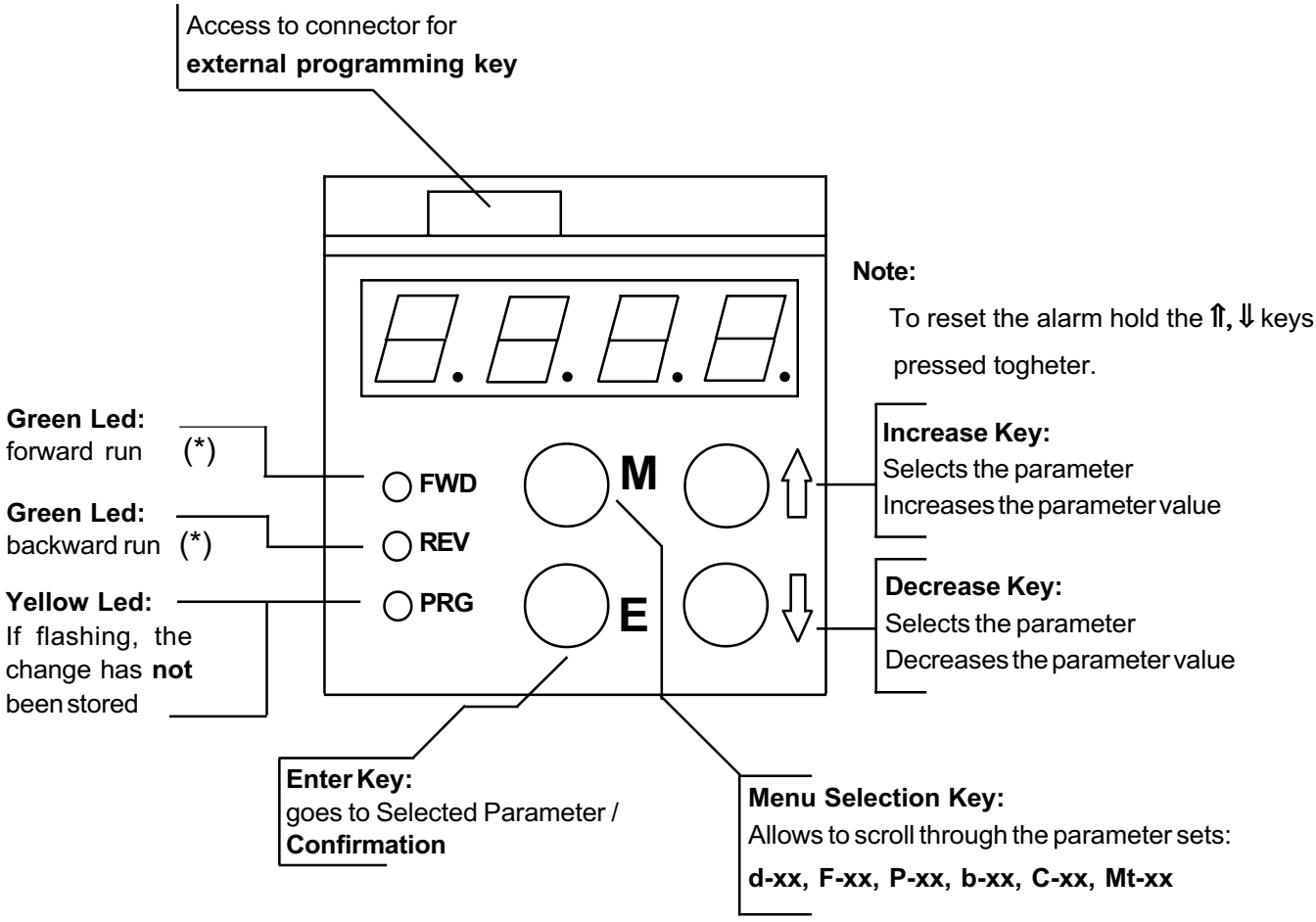
- **Stop**

To stop the motor, proceed as follows:
- Disable the run control. In this way, the motor is stopped with factory-preset ramp (5 seconds from max. frequency to 0 Hz).
- Or set to zero the speed reference potentiometer, so that the user has control over the motor stop.
  **Caution: in this case the motor is still live.**

- **The motor does not start**

If after enabling the run control, the motor does not start, first check that the connections shown on page 6 have been performed, then check that the factory-preset parameters meet the motor characteristics.
The parameters can be checked through the P menu. Press the **M** key until the P menu appears**,** then, through the ⇑ ⇓ keys, select the code of the parameter with the value to be checked and press the **E** key to get its value. Important are the data of the motor rating characteristics that can be set through the parameters P-01, P-02, P-09, P-11, P-12 (page 20).

**Control panel**




**Caution:** the changes made to parameter values have an immediate effect but are not automatically stored. The storage is performed through control **C- 00.**

**(*) NOTE:** the **flashing of Green Leeds,** indicates the action of the motor stall prevention.

- **The display** is used to show both letters and numbers, e.g.:

  **P-xx** means: **P** = letters indicating the selected menu
  **xx** = numeric code indicating the parameter progressive number
  **xxx.x** means: number, also decimal, indicating the value of the selected parameter

- The parameter sets, or **MENU**, have the following meaning:

  **d-xx** menu of read-only parameters (display)

  **F-xx** menu of read/write parameters of terminal-board selectable frequencies

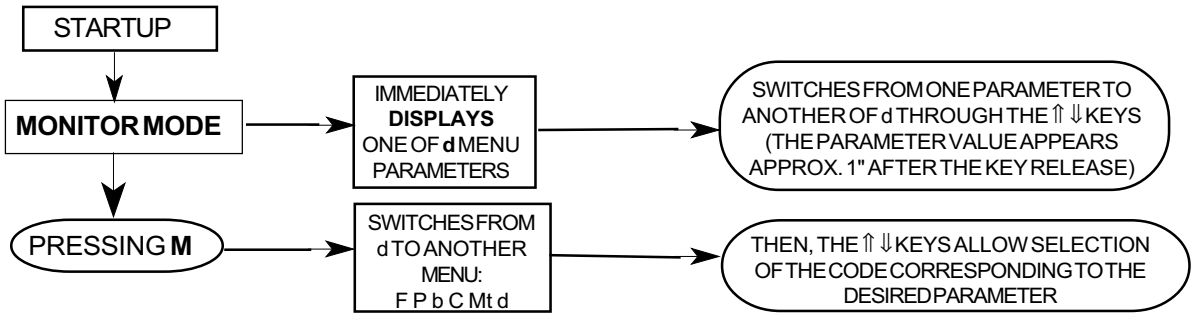
  **P-xx** menu of read/write parameters

  **b-xx** menu of read/write parameters, ON/OFF-type (they can be changed with stopped motor only)

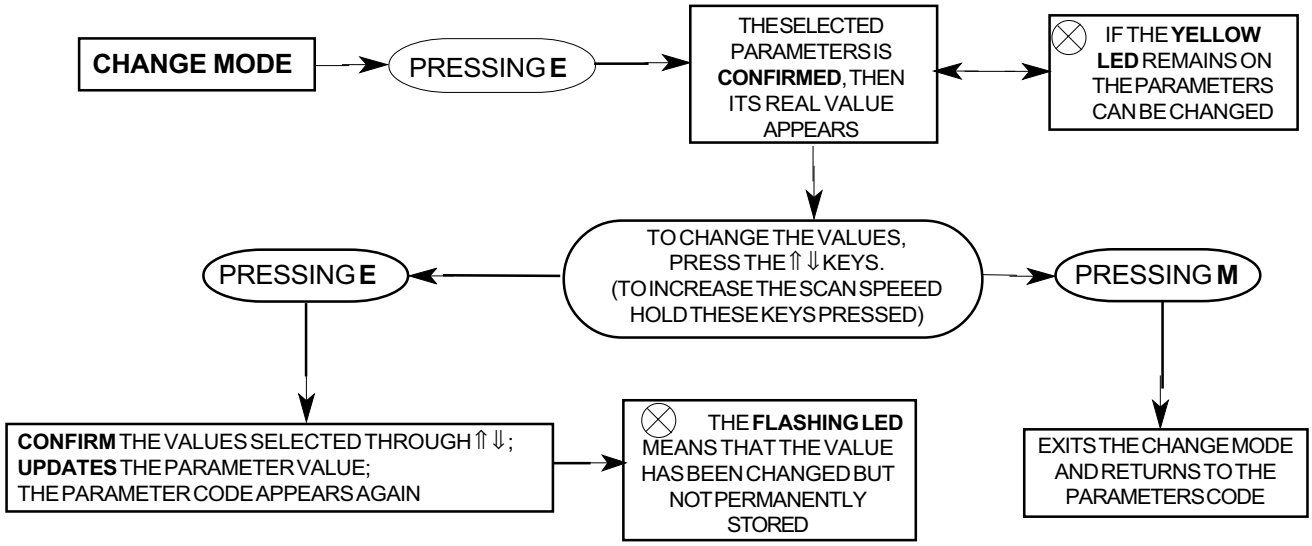
  **C-xx** menu of control-type parameters

  **Mt-xx** menu motopotenziometro

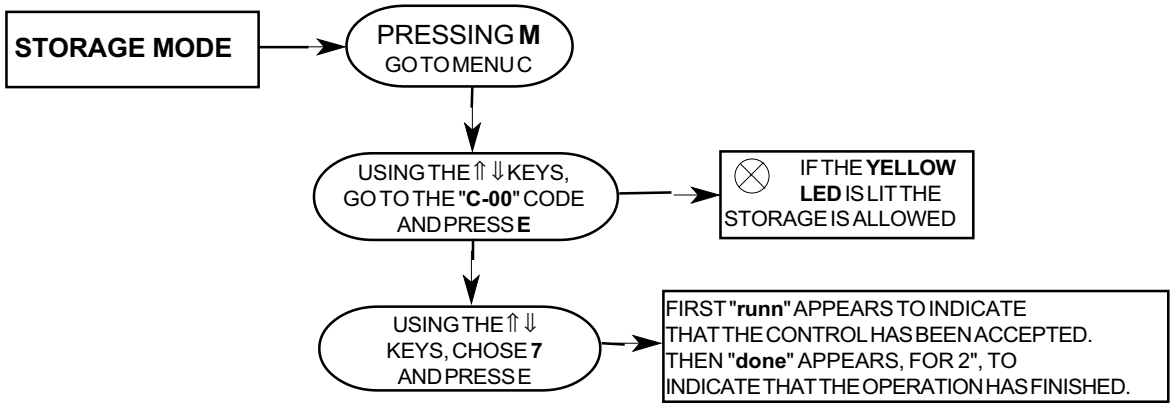
At **STARTUP** the conrol panel enters the **MONITOR** mode, thus allowing reading of the values assumed by the menu parameters: d, F, P, b, C, Mt. The following chart shows how to switch from one menu or parameter to another.


STARTUP
MONITOR MODE
IMMEDIATELY DISPLAYS ONE OF d MENU PARAMETERS
SWITCHES FROM ONE PARAMETER TO ANOTHER OF d THROUGH THE ⇑ ⇓ KEYS (THE PARAMETER VALUE APPEARS APPROX. 1" AFTER THE KEY RELEASE)
PRESSING M
SWITCHES FROM d TO ANOTHER MENU: F P b C Mt d
THEN, THE ⇑ ⇓ KEYS ALLOW SELECTION OF THE CODE CORRESPONDING TO THE DESIRED PARAMETER

To **CHANGE** a parameter value: **DISPLAY** the corresponding code, then accept the selection by pressing the **CONFIRMATION** key **E,** as shown in the following chart.

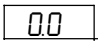

CHANGE MODE
PRESSING E
THE SELECTED PARAMETERS IS CONFIRMED, THEN ITS REAL VALUE APPEARS
IF THE YELLOW LED REMAINS ON THE PARAMETERS CAN BE CHANGED
TO CHANGE THE VALUES, PRESS THE ⇑ ⇓ KEYS. (TO INCREASE THE SCAN SPEEED HOLD THESE KEYS PRESSED)
PRESSING E
PRESSING M
CONFIRM THE VALUES SELECTED THROUGH ⇑ ⇓; UPDATES THE PARAMETER VALUE; THE PARAMETER CODE APPEARS AGAIN
THE FLASHING LED MEANS THAT THE VALUE HAS BEEN CHANGED BUT NOT PERMANENTLY STORED
EXITS THE CHANGE MODE AND RETURNS TO THE PARAMETERS CODE

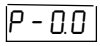
To **permanently STORE** the changes made, proceed as follows:

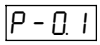

STORAGE MODE
PRESSING M
GO TO MENU C
USING THE ⇑ ⇓ KEYS, GO TO THE "C-00" CODE AND PRESS E
IF THE YELLOW LED IS LIT THE STORAGE IS ALLOWED
USING THE ⇑ ⇓ KEYS, CHOSE 7 AND PRESS E
FIRST "runn" APPEARS TO INDICATE THAT THE CONTROL HAS BEEN ACCEPTED. THEN "done" APPEARS, FOR 2", TO INDICATE THAT THE OPERATION HAS FINISHED.

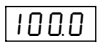
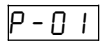
- **Changing the parameters**

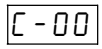
Procedure for parameter change. Let us assume we turned the inverter on and we want to change the value of the max. working frequency from 50 Hz (factory-preset value) to 100 Hz.

At start-up: ..... ON DISPLAY 

1 - Press **M** repeatedly until the **P** menu is displayed**:** ..... ON DISPLAY 

2 - Through the ⇑ ⇓ keys, select code **01,** .....ON DISPLAY 
press **E**;
the value of parameter **P-01** will be shown (max. working frequency) ..... ..... ON DISPLAY

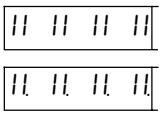
3 - Note the state of PRG LED (page 13): if it is permanently lit, the parameter can be modified. Press ⇑ to increase the number, ⇓ to decrease it (if the key is held down, the digit scan speed is increased). Now, press ⇑ until the display shows **100.0** ..... ON DISPLAY 
Press **E** to confirm and enable the value;
(the parameter code come back on display) ..... ON DISPLAY 
**NOTE:** In this way, the value of max. frequency has been changed, but not stored in a permanent way (**Yellow LED** is flashing).

4 - Press **M** until the **C** menu is displayed; through the ⇑ ⇓ keys, select the code **00**; ..... ON DISPLAY 
press **E** to accept the selection;
the PRG LED, if permanently lit, indicates the storage enabling.
Through the ⇑, ⇓ keys, go to code **7**..... ON DISPLAY
Press **E** to confirm the value;
The message "donE" will be displayed for 2 seconds to confirm the operation..... ON DISPLAY
The storage operation is completed.

**Display of parameters**

**d - MENU:** At startup, the inverter enters the **MONITOR MODE,** i.e. it is ready to display information about its operation, as shown on the table; first, the output frequency parameter is displayed. The same action is obtained by selecting the **d MENU** through the **M** key**.**
To facilitate the operation, the modifiable parameters are divided into three groups or levels. Whether the parameters of a given level (accessibility) can be changed or not depends on the presetting of parameter **P-20:**

P-20=1 → 1st level (factory preset)
P-20=2 → 2nd level
P-20=3 → 3rd level

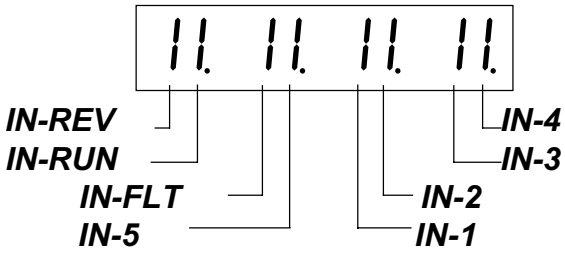
| CODE | DESCRIPTION | CHANGE RANGE | PRESET VALUE | UNIT |
|---|---|---|---|---|
| d - 00 | output frequency | | 0.1 | Hz |
| d - 01 | reference frequency | Fmin. to Fmax. | 0.1 | Hz |
| d - 02 | output current (rms) | | 0.1 | A |
| d - 03 | output voltage (rms) | | 1 | V |
| d - 04 | continuous voltage (dc) | | 1 | V |
| d - 05 | output speed **(d-00)*(P-16)** | | 0.01 / 0.1 / 1 | |
| d - 06 | reference speed **(d-01)*(P-16)** | | 0.01 / 0.1/1 | |
| d - 07 | cos φ | | 0.01 | |
| d - 08 | power | | 0.01 | Kw |
| d - 09 | inverter overload (100% = alarm threshold) | | 0.1 | % |
| d - 10 | motor overload (100% = alarm threshold) | | 0.1 | % |
| d - 11 | braking resistor overload (100% = alarm threshold) | | 0.1 | % |
| d - 12 | last alarm memory | to reset the alarm, use control **C-03** | | |
| d - 13 | second to last alarm memory | | | |
| d - 14 | third to last alarm memory | | | |
| d - 15 | fourth to last alarm memory | | | |
| d - 16 | digital inputs state |  | each vertical segment corresponds to an input or output state, as shown on the tables on next page | |
| d - 17 | digital outputs state | | | |
| d - 18 | 16-bit parallel port state | | | |
| d - 19 | encoder pulse number (for sampling period) | 1 / 10 | | |
| d - 20 | encoder frequency | 0,1 | | Hz |
| d - 21 | encoder speed **(d-00)*(P-16)** | 0.01/ 0.1/ 1 | | |
| d - 22 | PID reference | 0,1 | | % |
| d - 23 | PID feedback | 0,1 | | % |
| d - 24 | PID error | 0,1 | | % |
| d - 25 | PID integral component | 0,1 | | % |
| d - 26 | PID output | 0,1 | | % |
| d - 27 | inverter rated current | 0,1 | | A |
| d - 28 | software version | xx.xx | | |
| d - 29 | identification code file of power board configuration | xxxx | | |
| d - 30 | display test | all segments lit | | |
| d - 31 | software type (related to d-28) | xx.xx (starting from rev. 00.01) | | |

| CODE | DESCRIPTION | RANGE | PRESET VALUE | UNIT |
|---|---|---|---|---|
| d-32 | heatsink temperature displaying | | 1 | C° |
| d-33 | identification file code of parameters configuration | xxxx | | |
| d-34 | identification file code of regulation configuration | xxxx | | |
| d-35 | identification code of power size | xx | | |
| d-36 | regulation card temperature | | 1 | C° |

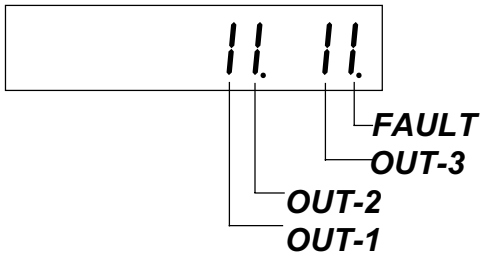
P-16 multiply factor for of parameters unit

**Note**: Each segment, when lit, indicates that the corresponding I / O is active.

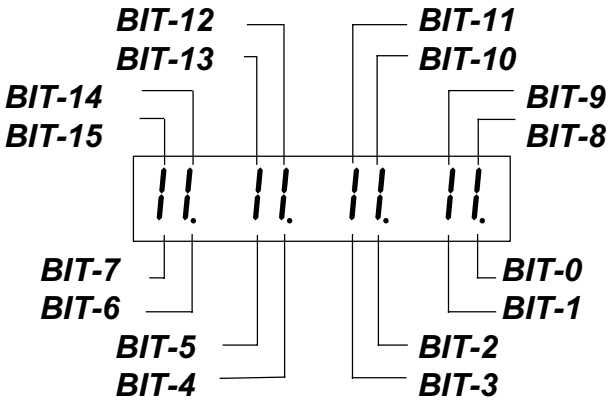
**- Inputs:**




**- Outputs:**




**- 16 bit input board:**



**F MENU:** it sets and/or reads the frequencies that can be selected through terminal board (Multispeed).

| CODE | DESCRIPTION | RANGE | UNIT | PRESET VALUE | PAGE |
|---|---|---|---|---|---|
| F - 00 | Reference frequency 0 | 0,0 / 500,0 | 0,1 Hz | 0,0 | 27 |
| F - 01 | Reference frequency 1 | " " | " " | " " | " |
| F - 02 | Reference frequency 2 | " " | " " | " " | " |
| F - 03 | Reference frequency 3 | " " | " " | " " | " |
| F - 04 | Reference frequency 4 | " " | " " | " " | " |
| F - 05 | Reference frequency 5 | " " | " " | " " | " |
| F - 06 | Reference frequency 6 | " " | " " | " " | " |
| F - 07 | Reference frequency 7 | " " | " " | " " | " |
| F - 08 | Jogging frequency | " " | " " | 1.0 | " |

**C MENU:** sets and executes some controls: to execute them, select value **7** and confirm through **E**.

| CODE | ACTION PERFORMED | |
|---|---|---|
| C - 00 | Permanent storage of all parameters | (*) |
| C - 01 | Recall of previously stored parameters (the currently used parameters are replaced by the previously stored ones) | (*) |
| C - 02 | Recall of factory-preset parameters (the storage depends on the operator's choice) | (*) |
| C - 03 | Zero setting of alarms memory | |
| C - 04 | Recall and storage of the parameters contained in the external programming key | (*) |
| C - 05 | Storage of the inverter parameters on external programming key | |
| C - 06 | Measure of motor phase resistance and corresponding initialization of parameter **P - 12** (page 24) | (*) |

**- PARAMETER PROTECTION:**

**Caution:** all parameters or part of them can be write-protected through param. **P - 19;** their reading will not be affected. In case of a modification attempt not authorised or not allowed with running motor, the following message will be displayed: Prot.
**NOTE: all parameters not shown on tables are reserved, consequently they must be always set to 0.**

| PARAMETER | ACTION PERFORMED |
|---|---|
| **P-19=0** | no protection |
| **P-19=1** | **F** parameters **not protected,** the others are protected |
| **P-19=2** | all parameters are protected |
| **P-19=3** | no protection; storage possibility with running motor too. **NOT RECOMMENDED** |

**NOTE: The sign (*) means the controls cannot be executed with running motor.**

**P MENU:** sets all the values of the inverter parameters; they are divided into three groups, or LEVELS, access to which depends on the code (1, 2, 3) set through parameter **P - 20.**

| Code | Description | Range | Unit | Preset value | | Page |
|---|---|---|---|---|---|---|
| | **Level 1** | | | | | |
| P - 00 | reference setting | 0 - 9 | 1 | 0 | | 25 |
| P - 01 | maximum frequency | 50,0 - 500,0 | 0,01 / 0,1 Hz | 50,00 | (*) | " |
| P - 02 | max. output voltage | (P-72) - (**) | 1 V | (**) | (*) | 28 |
| P - 03 | V/F characteristic type | 0 - 4 | 1 | 1 | (*) | " |
| P - 04 | torque boost at low revolutions | 0 - 30 | 1% di (P-02) | 3 | | " |
| P - 05 | acceleration time 1 | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | 29 |
| P - 06 | deceleration time 1 | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | " |
| P - 07 | "S"-curve characteristic | 0,0 - 10,0 | 0,1 s | 0,0 | | " |
| P - 08 | modulation frequency | 0 - (**) | 1 | (**) | (*) | " |
| P - 09 | motor rated current | (20%-150%)Inom | 0,1 A | Inom | | 31 |
| P - 10 | motor thermal constant | 1 - 120 | 1 min. | 30 | | " |
| P - 11 | rating of motor cos φ | 0,01 - 1,00 | 0,01 | (**) | | " |
| P - 12 | motor stator resistance | 0,0 - 99,99 | 0,01 ohm | (**) | | " |
| P - 13 | motor efficiency | 0 - 100% | 1 | 100 | | " |
| P - 14 | min. frequency (offset) for frequency analog reference | -500 /+500 | 0,1 / 1 Hz | 0,0 | | 26 |
| P - 15 | gain for frequency analog reference | 0,000 - 9,999 | 0,001 | 1,000 | | " |
| P - 16 | conversion constant ( *** ) | 0,01 - 99,99 | 0,01 | 1,00 | | 18 |
| P - 17 | display message setting at startup (**d-xx** value) | 0 - 36 | 1 | 0 | | |
| P - 19 | parameters protection code | 0 - 3 | 1 | 0 | | |
| P - 20 | programming level | 1 - 3 | 1 | 1 | | |
| | **Level 2** | | | | | |
| P - 21 | acceleration time 2 | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | 29 |
| P - 22 | deceleration time 2 | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | " |
| P - 23 | acceleration time 3 | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | " |
| P - 24 | deceleration time 3 | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | " |
| P - 25 | acceleration time 4 / acceleration time in jogging state | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | " |
| P - 26 | deceleration time 4 / deceleration time in jogging state | 0,01 - 9999 | 0,01 / 0,1 / 1 s | 5,0 | | " |
| P - 27 | resolution for accel./decel. ramps | 0=0,01 1=0,1 2=1 | 1s | 1 | | " |
| P - 28 | DC braking level | 0 - 100 | 1% of Inom | 0 | | 36 |
| P - 29 | frequency for DC braking enabling | 0,0 / 500,0 | 0,1 Hz | 0,0 | | " |
| P - 30 | DC braking time at start | 0,0 - 60,0 | 0,1 s | 0,0 | | " |
| P - 31 | DC braking time at stop | 0,0 - 60,0 | 0,1 s | 0,0 | | " |
| P - 32 | slip compensation | 0,0 - 25,0 | 0,1 % | 0,0 | | 31 |
| P - 33 | time constant of slip compensation | 0,0 - 10,0 | 0,1 s | 0,1 | | " |
| P - 34 | jump frequency 1 | 0,0 / 500,0 | 0,1 Hz | 0,0 | | 29 |
| P - 35 | jump frequency 2 | 0,0 / 500,0 | 0,1 Hz | 0,0 | | " |
| P - 36 | jump amplitude | 0,0 - 100,0 | 0,1 Hz | 0,0 | | " |
| P - 37 | output frequency upper limit | (P-38) + 1 | 1% di (P-01) | 100 | | " |
| P - 38 | output frequency lower limit | 0 - (P-37) | (P-37) - 1 | 0 | | " |
| P - 39 | IN1 input configuration | 0 - 17 | 1 | 1 | | 32 |
| P - 40 | IN2 input configuration | 0 - 17 | 1 | 2 | | " |
| P - 41 | IN3 input configuration | 0 - 17 | 1 | 3 | | " |
| P - 42 | IN4 input configuration | 0 - 17 | 1 | 4 | | " |
| P - 43 | IN5 input configuration | 0 - 17 | 1 | 0 | | " |

**NOTE: ( ** ) : the parameter values depend on the inverter size;**
**( * ) : the controls can be executed with stopped motor only;**
**(***) : P-16 allows to convert the frequency displayed in d-00 as output velocity or encoder velocity.**

**P MENU:**

| Code | Description | Range | Unit | Preset value | | Page |
|---|---|---|---|---|---|---|
| | **Level 2** | | | | | |
| P-44 | OUT1 output configuration (relais) | 0 - 39 | 1 | 0 | (*) | 35 |
| P-45 | OUT2 output configuration | 0 - 39 | 1 | 5 | (*) | " |
| P-46 | OUT3 output configuration (OUT3) | 0 - 39 | 1 | 2 | (*) | " |
| P-47 | auxiliary analog input configuration | 0 - 14 | 1 | 0 | (*) | 33 |
| P-48 | analog output 1 configuration | 0 - 30 | 1 | 0 | (*) | 34 |
| P-49 | analog output 1 offset | -9,99 / +9,99 | 0,01 V | 0,00 | | " |
| P-50 | analog output 1 gain | -9,99 / +9,99 | 0,01 | 1,00 | | " |
| P-51 | analog output 1 time constant | 0,00 - 2,50 | 0,01 s | 0,00 | | " |
| P-52 | max. amplitude of offset frequency from AUX-V | 0 - 100 | 1% of (P-01) | 0 | | |
| P-53 | signalling frequency | 0,0 - 500,0 | 0,1 Hz | 0,0 | | 35 |
| P-54 | hysteresis amplitude related to **P-53** | 0,0 - 100,0 | 0,1 Hz | 0,0 | | " |
| P-55 | current limit for overload | 20 - (**) | 1%(mot.) | 110 | | 31 |
| P-56 | delay time for overload signaling | 0,1 - 25,0 | 0,1 s | 0,1 | | " |
| P-57 | autoreset time | 0,1 - 60,0 | 0,1 s | 5,0 | | 40 |
| P-58 | number of autoreset attempts | 1 - 250 | 1 | 1 | | " |
| P-59 | encoder updating time | 0,0(=0,01) - 25,0 | 0,1 s | 0,1 | | 35 |
| P-60 | encoder pulses for motor pole pairs | 1 - 9999 | 1 | 100 | | " |
| P-61 | multiplication factor related to **P-60** | 0,01 - 99,99 | 0,01 | 1,00 | | " |
| P-62 | ohmic value of braking resistor | 1 - 250 | 1 ohm | (**) | | 36 |
| P-63 | braking resistor power | 10 - 25,00 | 0,01 W | (**) | | " |
| P-64 | braking resistor thermic constant | 5 - 1250 | 5 s | (**) | | " |
| P-65 | inputs setting by serial line enabling | 0 - 255 | 1 | 0 | | 42 |
| P-66 | outputs setting by serial line enabling | 0 - 15 | 1 | 0 | | " |
| P-67 | serial line configuration | 0 - 29 | 1 | 1 | | " |
| P-68 | serial line address | 0 - 99 | 1 | 0 | | " |
| P-69 | answer delay time on serial line | 0 - 250 | 1 ms | 1 | | " |
| | **Level 3** | | | | | |
| P-70 | base frequency | (P-71) - 480,0 | 0,1 Hz | 50,0 | (*) | 28 |
| P-71 | V / F intermediate frequency | 0 - (P-70) | 0,1 Hz | 25,0 | (*) | " |
| P-72 | V / F intermediate voltage | 0 - (P-02) | 1 V | (**) | (*) | " |
| P-73 | ramp start/stop frequency | 0 - 25,0 | 0,1 Hz | 0,0 | (*) | " |
| P-74 | output voltage reduction | 0 - 100 | 1%(P02) | 100 | | " |
| P-75 | undervoltage threshold | 40 - 80 | 1%(P02) | 50 | (*) | 31 |
| P-76 | max. time of short mains blackout | 0,1 - 25,0 | 0,1 s | 1,0 | (*) | " |
| P-77 | current limit during acc. for f<f_base (if b35=1 for dec.) | 20 - 200 | 1%(Inom) | (**) | | 30 |
| P-78 | current limit during acc. for f>f_base (if b35=1 for dec.) | 20 - 200 | 1%(Inom) | (**) | | " |
| P-79 | current limit at constant speed | 20 - 200 | 1%(Inom) | (**) | | " |
| P-80 | current limit for flying restart | 20 - 200 | 1%(Inom) | 120 | | 31 |
| P-81 | demagnetization min. time | 0,01 - 10,00 | 0,01 s | (**) | | " |
| P-82 | deceleration speed to prevent stall at constant speed | 0,1 - 25,0 | 0,1 s | 1,0 | | 30 |
| P-83 | frequency scan time during motor pickup | 0,1 - 25,0 | 0,1 s | 1,0 | | 31 |
| P-84 | voltage reset time | 0,1 - 25,0 | 0,1 s | 0,2 | | 28/31 |
| P-85 | tolerance at constant speed | 0,1 - 25,0 | 0,1 Hz | 0,5 | | 30 |
| P-86 | ramp end delay / constant speed | 0,1 - 25,0 | 0,1 s | 1,0 | | " |
| P-87 | magnetizing current compensation gain | 0 - 100 | 1 | 0 | | |
| P-88 | magnetiz.current compens. time constant | 0 - 3 | 1 | 0 | | |
| P-89 | reception time out (serial communication) | 0,0 - 25,0 | 0,1 | 0,0 | | 42 |

**NOTE: ( ** ) means the parameter values depend on the inverter size;**
**( * ) means the controls can be executed with stopped motor only.**

**P MENU:**

| CODE | DESCRIPTION | | RANGE | UNIT | PRESET VALUE | | PAG |
|---|---|---|---|---|---|---|---|
| | **Livello 3** | | | | | | |
| P-90 | PID reference | | 0,0 - 100,0 | 0,1 % | 0,0 | | 38 |
| P-91 | PID max. positive error | | 0,1 - 100,0 | 0,1 % | 5,0 | | " |
| P-92 | PID max. negative error | | 0,1 - 100,0 | 0,1 % | 5,0 | | " |
| P-93 | PID updating time | | 0,00(=0,005) - 2,50 | 0,01 s | 0,00 | | " |
| P-94 | proportional term gain | set 1 | 0,00 - 99,99 | 0,01 | 0,00 | | " |
| P-95 | integral action time | | 0,00 - 99,99 | 0,01 | 99,99 | | " |
| P-96 | derivative action time | | 0,00 - 99,99 | 0,01 | 0,00 | | " |
| P-97 | proportional term gain | set 2 | 0,00 - 99,99 | 0,01 | 0,00 | | " |
| P-98 | integral action time | | 0,00 - 99,99 | 0,01 | 99,99 | | " |
| P-99 | derivative action tim | | 0,00 - 99,99 | 0,01 | 0,00 | | " |
| P-100 | analogue output 2 configuration | | 0-30 | 1 | 3 | | 34 |
| P-101 | analogue output 2 offset | | -9,99/+9,99 | 0,01V | 0,00 | | " |
| P-102 | analogue output 2 gain | | -9,99/+9,99 | 0,01 | 1,00 | | " |
| P-103 | analogue output 2 time constant | | 0,00-2,50 | 0,01s | 1,00 | | " |
| P-104 | REV-V analog input offset | | -9,99 / +9,99 | 0,01V | 0,00 | | 33 |
| P-105 | REV-V analog input gain | | -9,99 / +9,99 | 0,01 | 1,00 | | " |
| P-106 | AUX-V analog input offset | | -9,99 / +9,99 | 0,01V | 0,00 | | " |
| P-107 | AUX-V analog input gain | | -9,99 / +9,99 | 0,01 | 1,00 | | " |
| P-108 | reserved | | | | | | |
| P-109 | reserved | | | | | | |
| P-110 | inverter nominal input voltage | | 110-220-380-460 | 1V | (**) | (*) | 28 |
| P-111 | TOP deceleration time (3-wire control commands) | | 0,00 - 9999 | 0,01/0,1/1s | 0,00 | | 27 |
| P-112 | mask of direction rotation (3-wire control commands) | | 0 - 255 | 1 | 0 | | " |
| P-113 | automatic DC braking level | | 0 a 100,0 | 1% (P02) | 0,0 | | 37 |
| P-114 | automatic DC braking frequency level enabling | | 0,0 - 50,0 | 0,1Hz | 0,0 | | " |
| P-115 | P-114 hysterisis | | 0,1 - 25,0 | 0,1Hz | 0,2 | | " |
| P-116 | acceleration time of DC braking output | | 0,01 - 250 | 0,01 / 0,1 /1s | 0,1 | | " |
| P-117 | deceleration time of DC braking input | | 0,01 - 250 | 0,01 / 0,1 /1s | 0,1 | | " |

**NOTE: ( ** ) means the parameter values depend on the inverter size;**
**( * ) means the controls can be executed with stopped motor only.**

**b MENU:**

It sets the values of ON / OFF type parameters; they are divided into three groups, or LEVELS, access to which depends on the code (1, 2, 3) set through parameter **P - 20.** They can all be modified **with stopped motor only.**

| Code | Description | Range | Unit | Preset value | | Page |
|---|---|---|---|---|---|---|
| | **Level 1** | | | | | |
| b - 00 | run/reversal inputs configuration | 0=RUN/REV | 1=FWD/REV | 0 | | 29 |
| b - 01 | stop mode | 0=in ramp | 1=coast | 0 | | 32 |
| b - 02 | reversal enabling | 0=off | 1=on | 1 | | " |
| b - 03 | protection | 0=off | 1=on | 1 | | " |
| b - 04 | reference inputs reversal | 0=off | 1=on | 0 | | 27 |
| b - 05 | current input | 0=0 / 20 mA | 1=4 / 20 mA | 1 | | 25 |
| b - 06 | enabling of motor overload protection | 0=off | 1=on | 1 | | 30 |
| b - 07 | motor type | 0=standard | 1=servo-ventilated | 0 | | " |
| b - 08 | configuration of external alarm input | 0=NO(nor. open) | 1=NC(nor. closed) | 0 | | 32 |
| b - 09 | external alarm tripping mode | 0=alarm/lock | 1=inverter disabl. | 0 | | " |
| b - 10 | external alarm detection mode | 0=always | 1=run only | 0 | | " |
| | **Level 2** | | | | | |
| b - 11 | autoreset handling in case of external alarm | 0=off | 1=on | 0 | | " |
| b - 12 | autoreset enabling | 0=off | 1=on | 0 | | 32/40 |
| b - 13 | enabling of autoreset attempts limitation | 0=off | 1=on | 0 | | 40 |
| b - 14 | enabling of autoreset of auto zero-setting attempts | 0=off | 1=on (10 min.) | 0 | | " |
| b - 15 | alarm contact during autoreset | 0=off | 1=on | 1 | | " |
| b - 16 | voltage reduction tripping mode | 0=always | 1=const. speed only | 0 | | 28 |
| b - 17 | enabling of momentary overload control | 0=off | 1=on | 0 | | 31 |
| b - 18 | tripping mode of momentary overload control | 0=always | 1=const. speed only | 0 | | " |
| b - 19 | enabling of momentary overload alarm | 0=off | 1=on | 0 | | " |
| b - 20 | enabling of braking resistor overload protection | 0=off | 1=on | 0 | | 36 |
| b - 21 | encoder enabling | 0=off | 1=on | 0 | | 35 |
| b - 22 | encoder phases configuration | 0=phase A | 1=phase A and B | 0 | | " |
| b - 23 | encoder used for motor pickup | 0=off | 1=on | 0 | | 31/35 |
| | **Level 3** | | | | | |
| b - 24 | stall prevention during acceleration | 0=off | 1=on | 1 | | 30 |
| b - 25 | stall prevention at constant speed | 0=off | 1=on | 1 | | " |
| b - 26 | stall prevention during deceleration | 0=off | 1=on | 1 | | " |
| b - 27 | overvoltage prevention | 0=off | 1=on | 0 | | " |
| b - 28 | prevention of short mains blackout | 0=off | 1=on | 0 | | 31 |
| b - 29 | motor pickup enabling (flying restart) | 0=off | 1=on | 0 | | " |
| b - 30 | scan start frequency for pickup control | 0=reference freq. | 1= max frequency. | 0 | | " |
| b - 31 | motor pickup at startup | 0=off | 1=on | 0 | | " |
| b - 32 | automatic adjustment of output voltage | 0=off | 1=on | 1 | | 28 |
| b - 33 | dead times compensation | 0=off | 1=on | 1 | | " |
| b - 34 | automatic boost enabling | 0=off | 1=on | 0 | | 31 |
| b - 35 | overcurrent stall prevention for deceleration ramp | 0=off | 1=on | 1 | | 30 |
| b - 36 | enabling of switching frequency reduction under 5 Hz | 0=off | 1=on | 0 | | |

**b MENU:**

| Code | Description | Range | Unit | Preset value | Page |
|---|---|---|---|---|---|
| | **Level 3** | | | | |
| b-37 | enabling of undervoltage alarm storage | 0=off | 1=on | 1 | 40 |
| b-38 | overmodulation (torque increasing) | 0=normal | 1=low | 0 | 32 |
| b-39 | keyboard controls enabling | 0=off | 1=on | 1 | 32/42 |
| b-40 | PID regulator enabling | 0=off | 1=on | 0 | 37/38 |
| b-41 | regulator tripping PID mode | 0=running | 1=const. speed run | 0 | " |
| b-42 | enabling of encoder / PID synchronism | 0=off | 1=on | 0 | " |
| b-43 | variable adjusted by PID regulator | 0=frequency | 1=voltage | 0 | " |
| b-44 | error sign reversal | 0=off | 1=on | 0 | " |
| b-45 | adjustment mode | 0=direct | 1=sum(feed/forw.) | 0 | " |
| b-46 | suppression of PID regulator positive output | 0=off | 1=on | 0 | " |
| b-47 | suppression of PID regulator negative output | 0=off | 1=on | 0 | " |
| b-48 | suppression of positive or negative integral term | 0=off | 1=on | 0 | " |
| b-49 | integral term initialization at start | 0=off | 1=on | 0 | " |
| b-50<br>b-51<br>b-52 | PID reference input switches | see following table | | | |
| b-53<br>b-54<br>b-55 | PID feedback input switches | see following table | | | |
| b-56 | reserved | | | | |
| b-57 | alarm fault relay configuration | 0=active with alarm | 1=active with no alarm | 0 | 35 |
| b-58 | inser. of termination character in the word of FOXLINK prot. | 0=off | 1=on | 0 | 36/42 |
| b-59 | "d" or "Mt-0" displaying at the drive power-on | 0= "d" menu | 1= "Mt-0" menu | 0 | |
| b-60 | DC braking enabling at the STOP through JOG command | 0=off | 1=on | 0 | 32 |
| b-61 | reserved | | | | |
| b-62 | advanced dead time compensation | 0=off | 1=on | 1 | 34 |
| b-63 | reverse rotation enabling with negative PID output | 0=off | 1=on | 0 | 39 |
| b-64 | overtemperature prevention at low speed rotation | 0=off | 1=on | 1 | 29 |
| b-65 | derivative PID selection | 0=error calculated | 1=feedback calculated | 0 | " |
| b-66 | dynamic limitation of current peak | 0=off | 1=on | 1 | |
| b-67 | 3-wire control command enabling | 0=off | 1=on | 0 | 27 |
| b-68 | automatic DC braking enabling | 0=off | 1=on | 0 | 37 |
| b-69 | overmodulation type | 0=linear | 1=not-linear | 1 | |

| | feedback switches | | | | reference switches | | |
|---|---|---|---|---|---|---|---|
| | b-55 | b-54 | b-53 | | b-52 | b-51 | b-50 |
| | - | - | - | reference frequency | 0 | 0 | 0 |
| encoder | 0 | 0 | 1 | encoder | 0 | 0 | 1 |
| AUX-V | 0 | 1 | 0 | AUX-V | 0 | 1 | 0 |
| REF-V | 0 | 1 | 1 | REF-V | 0 | 1 | 1 |
| REF-I | 1 | 0 | 0 | REF-I | 1 | 0 | 0 |
| | - | - | - | parameter P - 90 | 1 | 0 | 1 |
| | - | - | - | freq. after ramp | 1 | 1 | 0 |
| current | 1 | 0 | 1 | generator | - | - | - |
| torque | 1 | 1 | 0 | | - | - | - |
| power | 1 | 1 | 1 | | - | - | - |
| set to 0 | 0 | 0 | 0 | set to 0 | 1 | 1 | 1 |

**Frequency reference setting**

| PARA-METER | FUNCTION | RANGE [DEFAULT] | VALUES | DESCRIPTION | | | | ASSOCIATED PARAMETERS |
|---|---|---|---|---|---|---|---|---|
| P-00 | Determines the inverter operation frequency | 0 - 9 [ 0 ] | Each parameter value correspond to a different reference: | | | | | |
| | | | 0 | **REF-V** (0/10V) analog input with J8 jumper inserted | | | | P-01, P-14 P-15, b-04 |
| | | | 1 | **REF-V** (-/+10V) analog input with J8 jumper inserted - the polarity determines the rotation direction | | | | |
| | | | 2 | analog input: **REF-I** (0/20mA: **[b-05=0]** or 4/20mA: **[b-05=1]**) | | | | |
| | | | 3 | selects the frequency set by parameter **F-00** | | | | |
| | | | 4 | input from serial line with 0,01 Hz resolution | | | | |
| | | | 5 | input from encoder (with option encoder board only) | | | | |
| | | | 6 | parallel digital input | 8 bit | resolution 0,01 Hz | (with option parallel board only) | P-01 |
| | | | 7 | | 12 bit | | | |
| | | | 8 | | 16 bit | | | |
| | | | 9 | motorized potentiometer reference | | | | |
| P-01 | Indicates the max. operation frequency | 50,00 - 500,0 [ 50,00 ] (Hz) | The value set for P-01 indicates the max. operation frequency and also the full scale value for the analog inputs or the parallel digital inputs | | | | | |

**Motorpotentiometer reference by keypad**

As alternative of digital/analog input reference can be selected the Motorpotentiometer function, increasing and decreasing the frequency reference by the using of up and down bottoms on the drive keypad.

Follow the procedure below to enable the function:

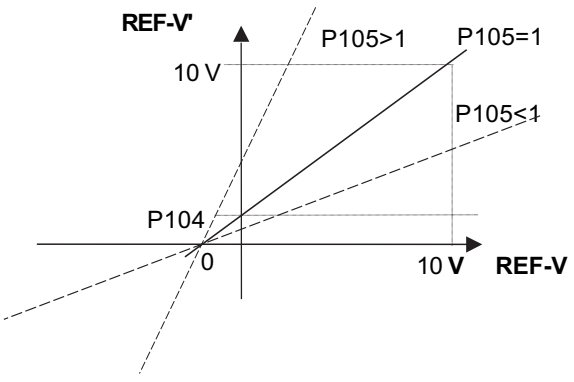
- Set P00=9 (frequency reference through motorpotentiometer)
- Access to "Mt" menu pushing "M" bottom
- Increase and decrease the frequency reference through ⇑ ⇓ bottoms. This function allows to storage the reference step, sets by the user before the drive power-off.
- Optional: with b59=1 the motorpotentiometer menu, "Mt", will be displayed at drive power on.

**NOTE! To use motorpotentiometer function the RUN input (terminal 2) is required as interlock**

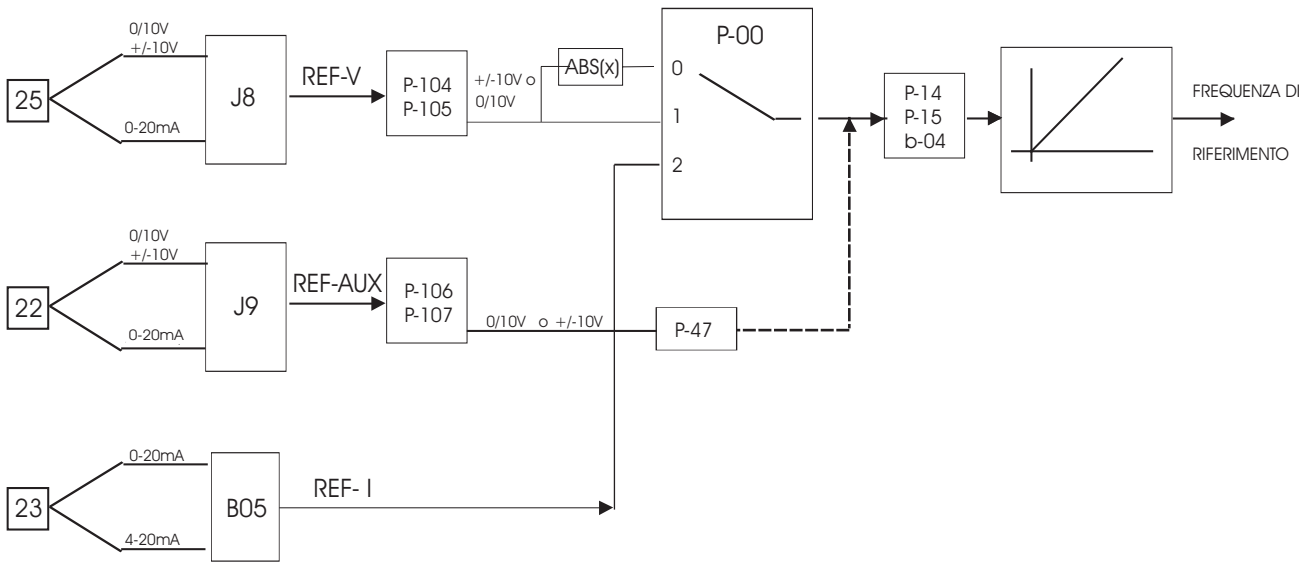
**Off-set compensation and scaling of REF-V and REF-I analog inputs**

Offset and Gain will be applied to the signal first; than it will be process by the drive calculation:

P-104 REF-V off-set (it can be also negative)
P-105 REF-V gain (it can be also negative)
P-106 AUX-V off-set (it can be also negative)
P-107 AUX-V gain (it can be also negative)




$$Vrif' = \left(\frac{(P01 - P104)}{10} * P105\right) * Vrif$$

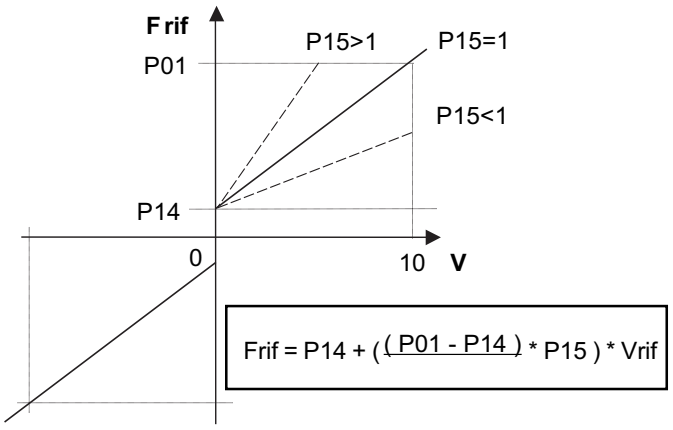



When selecting the analog input, it is possible to change the formula that transforms the reference input signal into the motor supply frequency through the following parameters:

| | |
|---|---|
| P-14 | minimum frequency (offset); it can be also negative. |
| P-15 | multiply gain factor G= P15 * (P01-P14)/10. |
| b-04 | enables the formula reversal (a minimum signal corresponds to a maximum frequency). |

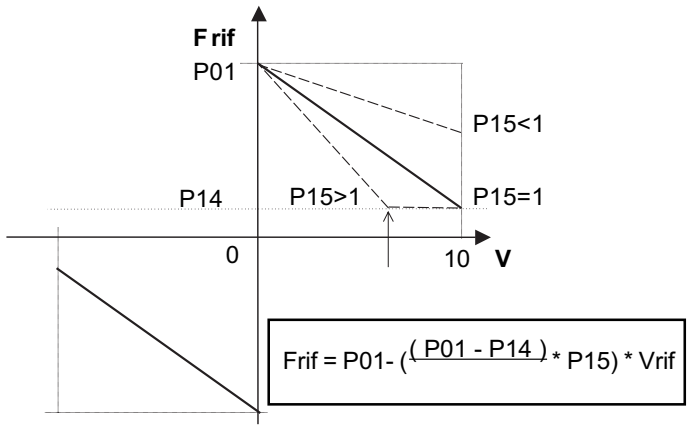
**Example:** with P-00 = 1, main reference is -10/+10 V analog input type:

Direct formula: **b-04=0** with **P14 > 0**



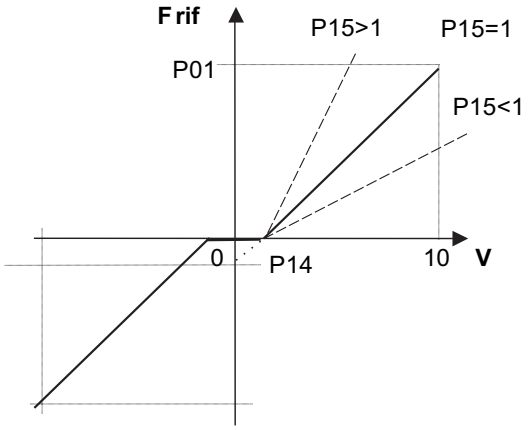

$$Frif = P14 + \left(\frac{(P01 - P14)}{} * P15\right) * Vrif$$

Inverse formula: **b-04=1** with **P14 > 0**



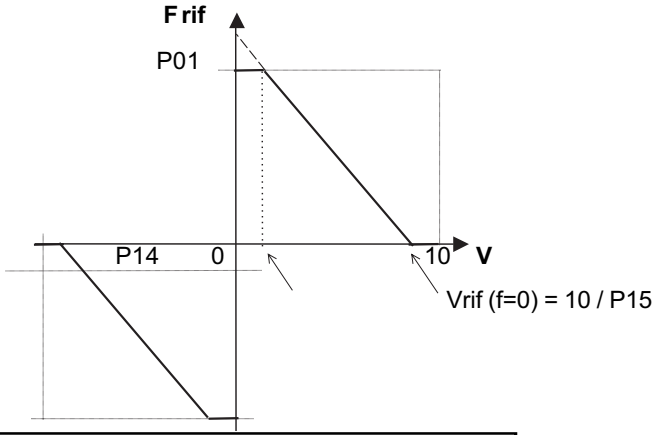

$$Frif = P01 - \left(\frac{(P01 - P14)}{} * P15\right) * Vrif$$

Direct formula: **b-04=0** with **P14 < 0**




$$Vrif\ (f=0) = (10 / P15) * (P14 / (P14 - P01))$$

Inverse formula: **b-04=1** with **P14 < 0**




$$Frif = (P01 - P14) - \left(\frac{(P01 - P14)}{} * P15\right) * Vrif$$

In any case Fref. will always be limited between **P-73** and **P-01**.

**Reference by digital inputs**

As a alternative to the above mentioned method, the frequency reference can be selected by re-calling some frequencies preset through parameters **F**, by means of some contacts to be connected to 3 of the 5 digital input corresponding to terminals 17, 18, 19, 20, 4 of the control terminal board (figures on page 8 and 9).
To do so, you must configure as a reference frequency switches, 3 of the 5 inputs with parameters, according to the following order**: P-39**, **P-40**, **P-41**, **P-42**, **P-43**. These inputs state will give the result indicated on the following table:

| | INPUTS | | | DESCRIPTION |
|---|---|---|---|---|
| VALUES | Ix-F3 | Ix-F2 | Ix-F1 | |
| | off | off | off | the main reference selected through parameter **P-00** is active |
| | off | off | on | frequency **F-01** (or the reference from **AUX-V** if **P-47=1**) is active |
| | off | on | off | frequency **F-02** is active |
| | off | on | on | frequency **F-03** is active |
| | on | off | off | frequency **F-04** is active |
| | on | off | on | frequency **F-05** is active |
| | on | on | off | frequency **F-06** is active |
| | on | on | on | frequency **F-07** is active |

**NOTE: The " on " state indicates a closed contact; the selection switches not used are considered as " off ".**

**3-wire control commands function**

This function can be activade by **B-67 = 1.**
It allows to give Run command and select one of the frequency steps programmed with **F-01** - **F-07** and **P-11**2, only if 3-wire control commands enabled.
REV, RUN and IN5 inputs become frequency selectors (positive/negative direction) according to the following table:

| Morsetti | | | Riferimento | Funzione |
|---|---|---|---|---|
| *REV* | *RUN* | *IN5* | | |
| off | off | off | - | STOP |
| off | off | on | F-01 | RUN – direzione bit1 di P-112 |
| off | on | off | F-02 | RUN – direzione bit2 di P-112 |
| off | on | on | F–03 | RUN – direzione bit3 di P-112 |
| on | off | off | F–04 | RUN – direzione bit4 di P-112 |
| on | off | on | F–05 | RUN – direzione bit5 di P-112 |
| on | on | off | F–06 | RUN – direzione bit6 di P-112 |
| on | on | on | F–07 | RUN – direzione bit7 di P-112 |

ON" means contact closed; "OFF" means contact open

For Run command activation, it is necessary to give one of 3 input; the selection of frequency step programmed depends by the combination of 3 inputs control.

P-112 parameter determines the frequency sign, so the motor direction. It is a 8 bit value, where each bit assumes a digital frequency step: 0 means forward direction and 1 means reverse direction.

| | P-112 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Posizione | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
| F associata | F-07 | F-06 | F-05 | F-04 | F-03 | F-02 | F-01 | - |
| Peso | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |

To calculate P-112 parameter value, it is necessary to sum each bit value that has been set to 1.
Example: if it is necessary to use F-01 and F-05 as REV direction and all the others as FWD: bit 1 and bit 5 of P-112 must set to 1; all the others must be set to 0.
P-112 value will be 2 + 32 = 34 (sum of F-01 and F-05 values).
P-112 defult value is 0; it means FWD direction for all the digital frequency reference.

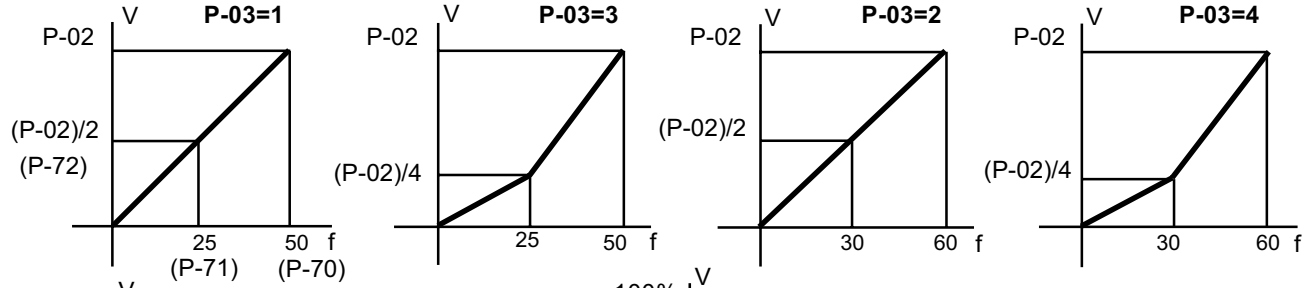
From STOP to RUN and during multi frequencies selection are executed the standard acceleration/deceleration ramps; from RUN to STOP (when there are not any command applied to the terminals) the deceleration ramp is determined by P-111 parameter.
If P-111 is 0 (default) the deceleration ramp is not executed; the motor will coast to stop.

**Frequency characteristic**

| PARAMETER | FUNCTION | RANGE [DEFAULT] | VALUES | DESCRIPTION | ASSOCIATED PARAMETERS |
|---|---|---|---|---|---|
| P-03 | Determines the voltage to be applied to the motor as a function of the frequency | 0 - 4 [ 1 ] | Each parameter value correspond to a different characteristic: | | |
| | | | 0 | user-defined characteristic | P-02 P-04 P-70 P-71 P-72 P-73 P-74 P-84 b-16 b-32 |
| | | | 1 | linear characteristic for 50 Hz motors | P-02 P-04 P-73 P-74 P-84 b-16 b-32 |
| | | | 2 | linear characteristic for 60 Hz motors | |
| | | | 3 | quadratic characteristic for 50 Hz motors | |
| | | | 4 | quadratic characteristic for 60 Hz motors | |

| PARAMETER | FUNCTION | RANGE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| P-70 | To customize the characteristic: **the change is possible only if P-03 = 0** | (P-71) - 480,0 [ 50,0 ] (Hz) | Selects the motor base frequency (rated); this frequency is associated to the motor max. voltage set through **P-02**. |
| P-71 | | 0 - (P-70) [ 25,0 ] (Hz) | Selects the intermediate frequency. |
| P-72 | | 0 - (P-02) [ (**) ] (V) | Selects the voltage applied to the motor as regards the intermediate frequency. |
| P-02 | Selects the max. voltage applied to the motor. | (P-72) - (**) [ (**) ] (V) | To make this value independent from the inverter supply voltage fluctuation enable the automatic adjustement function of the output voltage by setting **b-32=1**. In this case, the inverter can be supplied through a voltage higher than the motor rated one. If **b-32=0** then the voltage value setted by P-02 must matches the motor rated voltage. |
| P-110 | Inverter nominal input voltage. | 110-220-380-460 (V) | It allows to select the nominal input voltage, provided by the inverter. The selection of input voltage will automatically set the values of D27, P02, P09, P72 par. |
| P-04 | Increases the output voltage at 0 Hz (calculated in % of P-02) and also the torque. | 0 - 30 [ 3 ] | The value of the applied voltage can be controlled through the terminal board by applying a 0/10 V signal to the **AUX-V** input (term. 22) and setting **P-47=10**.This voltage is added to the V/F characteristic in a decreasing way, until it is annulled at the intermediate frequency (**P-71**). (fig. A) |
| P-73 | Selects the frequency applied to the motor at start. | 0 - 25,0 [ 0,0 ] (Hz) | Is the ramp begin frequency at start and the ramp end frequency at stop. |
| P-74 | Limits the voltage value applied to the motor (in % of P-02). | 0 - 100 [ 100 ] | The maximum output voltage value is limited to (**P-74***P-02)/100 value. This value can be adjusted through terminal board by applying a 0/10 V signal to the **AUX-V** input (term. 22) and setting **P-47=2** |
| b-16 | Controls the voltage reduction set through parameter P-74. | 0=always; 1=const.speed only [ 0 ] | If **b-16=0,** the reduction is always active; if **b-16=1** the reduction is inactive during the ramps, so that the torque is completely available both in acceleration and decelerazione state. (fig. B) |
| P-84 | Determines the max. speed of voltage change. | 0,1 - 25,0 (s) [ 0,2 ] | Time to go to from 0% to 100% of V and viceversa **NOTE : too short times cause excessive current peaks.** |

**[ (**) ] = The default values of the parameters depends on the inverter size**.



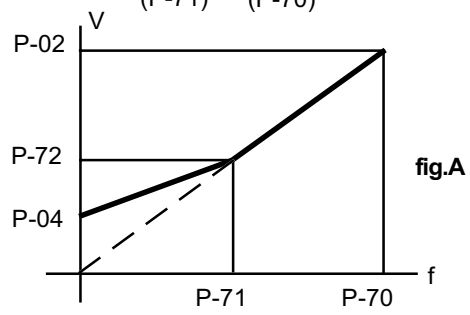




**fig.A**

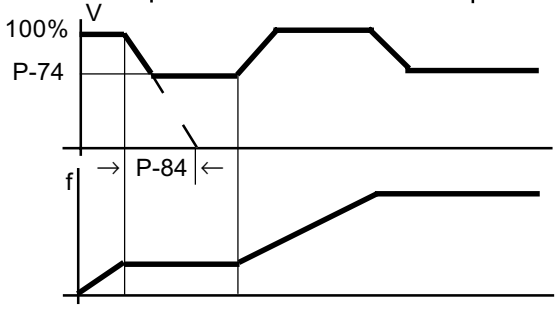



**fig.B**

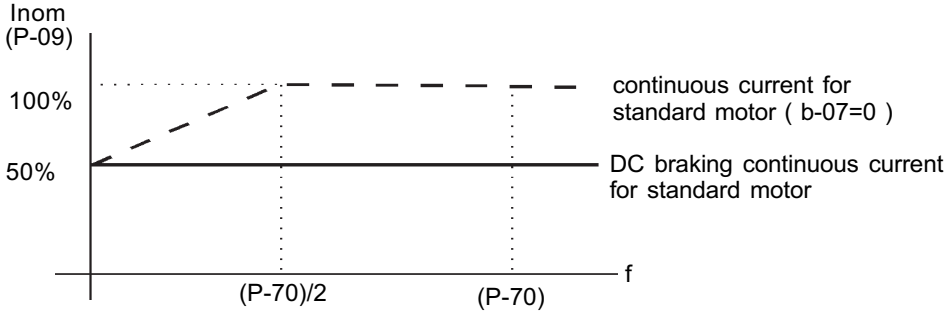
**Frequency jumps - Output frequency limitations - Jogging - Switching frequency - Accel. and decel. ramps**

| PARAMETER | FUNCTION | RANGE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| P-34 | Jump frequency no. 1 | 0,0 - 500,0 [ 0,0 ] (Hz) | Particular frequencies with which the inverter supplies the motor can cause undesired vibrations to the mechanical parts coupled to the motor. Parameters **P-34** and **P-35** can be set to exclude two of these frequency. |
| P-35 | Jump frequency no. 2 | 0,0 - 500,0 [ 0,0 ] (Hz) | |
| P-36 | The frequency interval Δf to the left or right of the jump frequency | 0,0 - 100,0 [ 0,0 ] (Hz) | Defines the frequency interval amplitude, to the left or right of the jump frequency.E.g.: the interval around jump frequency no. 1 ranges from (**P-34**)-(**P-36**) to (**P-34**)+(**P-36**). **Note: the two intervals can overlap. To disable an interval, the related frequency set by P-34 or P-35 must be set to 0 Hz.** |
| P-37 | Upper limit of the output frequency (% di P-01) | (P-38) - 110 [ 100 ] | The output frequency can be limited independently of the maximum and minimum values defined by parameters **P-01** e **P-14**. The output frequency can exceed the maximum frequency set by **P-01** up to the max. value of 110%. This is done by using the slip compensation function or the speed feedback with the PID regulator. |
| P-38 | Lower limit of the output frequency (% di P-01) | 0 - (P-37) [ 0 ] | |
| b-00 | Selects the sequence followed by the RUN and REV togheter with the input Ix-JOG | 0 = off - 1 = on [ 0 ] | **JOGGING** is a particular run control to advance the motor by small amounts. It applies preset frequencies to the motor through parameter **F-08** with acceleration and deceleration ramps set through parameters **P-25, P-26**. DC braking at the start not enabled; use b-60 parameter to enable the DC braking at the stop If **b-00 = 0**: RUN = run, REV = reversal, and the input **Ix-JOG** handles the jogging control. If RUN and **Ix-JOG** are simultaneously enabled the first one enabled will override the other one.If **b-00 = 1**: RUN = forward run, REV = backward run, the **Ix-JOG** enables the jogging control that overrides the normal run control. |
| P-08 | Selects switching frequency (executable with stopped motor only) | 0 - (**) (**) | 0 = 1kHz; 1 = 2 kHz; 2 = 3 kHz; 3 = 6 kHz; 4 = 9 kHz; 5 = 12 kHz; 6 = 15 kHz; 7 = 18 kHz. High values of the switching frequency reduce or eliminate the electric "noise" generated by the motor; viceversa, low values give a higher rotation fluidity at low speed, especially if high torques are required. |
| b-33 | Dead time compensation | 0 = off - 1 = on [ 1 ] | Dead times compensation: it improves the torque and fluidity actions at low speed. |
| b-62 | Advanced dead time compensation enabling. | 0 = off - 1 = on [1] | "0" means standard dead time compensation; "1" means advanced dead time compensation, which performs sinusoidal signal of output current at low speed rotation. |
| b-69 | Optimization of high frequency commutation | 0 = off - 1 = on [ 0 ] | "0" means standard sinusoidal modulation; "1" means flat sinusoidal modulation, which optimize the inverter heatsink temperature with high frequency commutation. |
| b-36 | | 0 = off - 1 = on [ 0 ] | Frequency automatic commutation to 3 kHz, when output frequency goes below 5 Hz. |
| b-64 | Overtemperature prevention at low speed. | 0 = off - 1 = on [1] | "1" means overtemperature prevention at low speed rotation; the inverter will have in general a better efficiency, fluid motor rotation and low electromagnetic emission. |
| P-39<br>P-40<br>P-41<br>P-42<br>P-43 | Configure 2 out of 5 control block inputs as ramp selectors | 5 / 6 | **5** enables **Ix-T1** as ramp selector - **6** enables **Ix-T2** as ramp selectors<br>The **Ix-T1** and **Ix-T2** inputs state (page 28), given by the contacts connected to the terminal board, will give the result shown on the following table:<br>**Ix-T2** / **Ix-T1** / **DESCRIPTION**<br>off / off / accel./decel. ramp 1 (**P05** = accel. time - **P06** = decel. time)<br>off / on / accel./decel. ramp 2 (**P21** = accel. time - **P22** = decel. time)<br>on / off / accel./decel. ramp 3 (**P23** = accel. time - **P24** = decel. time)<br>on / on / accel./decel. ramp 4 (**P25** = accel. time - **P26** = decel. time)<br>**Note:** a) **on** = closed contact; the controls not used are considered in **off** state.<br>b) When the jogging control **Ix-JOG** is active (page 28), the ramp pair 4 is automatically chosen. The acceleration and deceleration times are necessary to switch from zero Hz to the max. frequency, (P-01), and viceversa.<br>c) The modification of **P-27** can affect the values entered on **P-01, P-02, P-21, P-22, P-23, P-24, P-25, P-26** so these values must be rechecked.<br>d) If a variable signal between 0V and 10V is connected to the **AUX-V** input the accel./decel. ramps can be extended proportionally to this signal value, under control of **P-47**; (e.g.: 2(s) x 8(V)= 16 s ramp extension).<br>e)**The ramp extension can also be generated if the functions of motor stall and inverter lock are enabled. This actuation is signaled by a flashing GREEN LED and also on terminal board by properly programming OUT1/2/3.** |
| P-07 | Select the ramp form | 0,0 = linear ramp from 0,1s - 10,0 s = "S" shaped ramp from | |
| P-27 | Selects the resolution trough wich the ramp times are defined | 0 = 0,01 s - 99,99 s<br>1 = 0,1 s - 999,9 s<br>2 = 1s - 9999 s<br>[ 1 ] | |

(**) The default values of the parameters depends on the inverter size.

**Motor data setting - Motor thermal protection - Prevention of motor stall - inverter lock**

| PARA METER | FUNCTION | RANGE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| P - 09 | Motor rated current ( from the rating) | (20% - 150%) Inom. [ Inom ] (A) | To take advantage of the inverter/motor system features, it is necessary to set the characteristics of the motor used, through the parameters. **P-10** can be calculated, (necessary only if the motor thermal protection function is enabled, par. **b-06**). The higher the value set, the higher the motor capacity of supporting currents higher than the rated one. The value of **P-12** represents the motor phase resistance in case of star connection, or 1/3 of the phase resistance in case of delta connection. To get the proper value of **P-12**, use the function **C-06:** - 1) Use **M** to select the **C** menu ..... INDICAZIONE DISPLAY: C - 00 - 2) Use the ⇑, ⇓ keys to select the code 06 ..... INDICAZIONE DISPLAY: C - 06 and press **E:** the display will show the value of **C-06** ..... INDICAZIONE DISPLAY: 0 - 3) Use the ⇑, ⇓ keys to select the code 07 and press **E:** INDICAZIONE DISPLAY: 7 the stator resistence is automatically measured . The display will confirm that the operation has been executed .(To see the measured value, read the value of P-12 that, if necessary, can be manually modified). |
| P - 10 | Sets the motor thermic constant | 1 - (120) [ 30 ] (min) | |
| P - 11 | Motor cos j (obtained from the rating) | 0,01 - 1,00 [ (**) ] | |
| P - 12 | Equivalent stator resistance | 0,00 - 99,99 (**)] (ohm) | |
| b - 06 | Enable the termal protection of the motor | 0 = off - 1 = on [ 1 ] | **b-07=0**: standard motor, not servo-ventilated, at low revolution number not able to support the rated current (derating), the continuous current of DC braking is reduced by 50% (the motor is able to support a continuous current that is 50% of the rated one). **b-07=1** = servo-ventilated motor;specify the type of motor used through parameter **b-07.**The level reached by the protection can be read in **d-10,** measured in % of the max. thermic overload allowed for the motor. When this level reaches 100%, the protection trips and the inverter is locked. |
| b - 07 | Natural or assisted motor ventilation. | 0= standard 1= servo-ventilated | |
| b - 24 | Limits the acceleration current. | 0 = off - 1 = on [ 1 ] | Excessive current or voltage can cause motor stall or inverter lock conditions due to protections tripping.The aim of the parameter is to set thresholds that, when exceeded, trip some actions that limit currents and voltages: **b-24:** if the threshold programmed through **P-77** (in acceleration state and if **f<P-70**, constant torque zone), or through **P-78** ((in acceleration state and if **f>P-70**, constant power zone) is exceeded, the ramp is stopped until the current remains over this threshold. When **b-35**=1, **P-77** and **P-78** have effect during deceleration too. **b-25:** if the threshold programmed through **P-79** is exceeded (constant speed operation) the output frequency is reduced at a rate controlled by **P-82;** As soon as I falls below the theshold the frequency start to increase with the selected ramp. **b-26:** the ramp is stopped when the voltage on filter capacitors is near the overvoltage threshold; when the V falls under the threshold the ramp start again; **NOTE:** the function can be unable to prevent the inverter lock in case of high-inertia loads and short ramps. **b-27:** if the voltage on filter capacitors exceeds the overvoltage threshold, the output voltage is set to zero (corresponding to a coast-to-stop). As soon as the voltage reaches safety levels,a free rotation motor pickup is executed and the deceleration ramp is restarted. **NOTE: too short ramps can lock the inverter by overvoltage.** |
| b - 25 | Limits the current at constant speed. | 0 = off - 1 = on [ 1 ] | |
| b - 26 | Limits the voltage during deceleration . | 0 = off - 1 = on [ 1 ] | |
| b - 27 | Prevents overvoltage. | 0 = off - 1 = on [ 0 ] | |
| b - 35 | Prevenzione dello stallo per sovracar. in decelerazione | 0 = off - 1 = on [ 1 ] | |
| P - 77 P - 78 P - 79 | The parameters set the current threshold as a % of Inom | 20 - (**) [ **] | |
| P - 82 | Set the deceleration ramp when b-25 is active | 0,1 - 25,0 [ 1 ] ( s) | |
| P - 85 | Set max. reference Df after wich start the ramp state. | 0,1 - 25,0 [ 0,5 ] ( Hz ) | The parameters allows to distinguish between the acceleration or deceleration state and the constant speed state . In fact, acceleration ramps too short asregards the motor capacity, or slight reference variations, either intentional or not, does not mean the motor to be considered in constant acceleration or deceleration. The switching from one state to the other can be controlled through P-85, P-86: **P-85** set the indifference range to reference change as regards the constant speed; **P-86,** instead, set the time after which, starting from ramp completion, the motor is considered to be in constant speed state. |
| P - 86 | Set the delay after wich the motor is considered in constant speed state. | 0,1 - 25,0 [ 0,1 ] ( s ) | |



**Slip compensation - Instantaneous overload signalling - Prevention of short mains blackout - Pickup of motor in free rotation (flying restart) - Automatic boost**

| PARAMETER | FUNCTION | RANGE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| P-32 | Defines value of the motor rated slip (expressed in %) | 0,0 - 25,0 [ 0,0 ] | The parameters compensate for the motor speed reduction when increasing the applied load (slip), changing the inverter output frequency proportionally to the applied load. **Note**: a too quick response (**P-33** too short) can cause fluctuations in the output frequency. To obtain a good compensation properly set **P-09, P-11, P-12** and if the reference frequency is close to the maximum frequency, it is advisable to set on P-37 a value beyond 100% |
| P-33 | Compensation time constant | 0,0 - 10,0 [ 0,1 ] ( s ) | |
| b-17 | Enable the overload detection function | 0 = off - 1 = on [ 0 ] | The aim of the function which detects the overload is to signal or avoid excessive efforts on the load, causing the istantaneous locking of the inverter and the allarm signalling. The treshold defined by **P-55** is in % of the motor rated load as obtained through parameters **P-09, P-11.** The threshold exceeding can be signalled through terminal board by configuring the **Ox-GTT** output. The parameter **P-12** must be accurately set too. **P-56** Set how long the overload can exceed the tripping threshold before the signalling and the inverter lock functions are enabled |
| b-18 | Select when the detection function is active | 0=always - 1= at constant speed [ 0 ] | |
| b-19 | Set the overload locked state | 0 = off - 1 = on [ 0 ] | |
| P-55 | Set the tripping tlevel of the protection | 20 - (**) [ 110 ] ( % ) | |
| P-56 | Set the delay before the protection trip | 0,1 - 25,0 [ 0,1 ] ( s ) | |
| b-28 | Enables the prevention of short mains blackout | 0 = off - 1 = on [ 0 ] | The parameters avoid locking the inverter when happen a short mains blackout.The mains cut off is signaled on the display and on the terminal board by configuring one of digital outputs **OUT1, OUT2, OUT3**. **Note: 1)**on single phase inverter it is advisable to reduce the **P-75** value to the minimum to prevent excessive startup currents. Otherwise it is possible that the inverter lock by undervoltage. The alarm is always enabled if the voltage falls under a given value that depends on the inverter size; **2)** the tripping of the prevention function sets the output voltage to zero, (coast-to-stop). In this way, the filter capacitors are not completely discharged thus keeping the control logic active. As soon as the voltage exceeds the threshold (hysteresis of 6%), a pickup phase of motor in free rotation is performed, thus resetting the speed in force before the tripping. |
| P-75 | Determines the undervoltage protection tripping threshold | 40 - 80 (% of P-02) [ 70 ] | |
| P-76 | Set the max. duration of the short mains blackout before the undervoltage alarm is enabled | 0,1 - 25,0 [ 1 ] ( s ) | |
| b-29 | Enables the tripping of the motor pickup | 0 = off - 1 = on [ 0 ] | The aim of the pickup function of motor in free rotation is to avoid the higher than normal startup currents generated when, for some causes the inverter cuts the voltage to the motor, then a subsequent run command makes a start from zero Hz with the motor still rotating. This function generates an initial frequency, **b-30**, equal to or higher than the motor one, by gradually increasing, **P-84**, the output voltage to 100 % and controlling that the current does not exceed a preset threshold set by **P-80**, (it is advisable that this value should be lightly higher than the current absorbed by the motor ) otherwise the output frequency would be reduced and the voltage would be limited. The delay between the cut off of the motor voltage and when the motor pickup phase start can be controlled by **P-81** (demagnetization time)**.** The motor is considered frequency-locked when a given frequency is reached so that, at full voltage, the current is under the threshold. The motor can then be accelerated or decelerated until the reference is reached. **b-23** enables the uses of a frequency obtained from an encoder as initial frequency for motor pickup. The motor pickup function can be enabled through terminal board by configuring one of the inputs as **Ix-FLY** input. If the Ix-FLY input is active, every time the run control is pressed the motor pickup is performed. |
| b-30 | Selects the initial scanning frequency | 0=reference freq. 1=max. frequency [ 0 ] | |
| b-31 | Enables the function with the firs trun control after startup | 0 = off - 1 = on [ 0 ] | |
| P-80 | Sets the max. current threshold during the motor pickup phase | 20 - (**) (% of Inom) [ 120 ] | |
| P-81 | Delay to activate the motor pickup function | 0,01 - 10,00 [ ** ] ( s ) | |
| P-83 | Sets the rate of change of the frequency during the lock search | 0,1 - 25,0 [ 1 ] ( s ) | |
| P-84 | Set the max. rate of change of the voltage | 0,1 - 25,0 [ 0,2 ] ( s ) | |
| b-23 | Enables the uses of an encoder for the motor pickup function | 0 = off - 1 = on [ 0 ] | |
| b-34 | Enables the automatic boost | 0 = off - 1 = on [ 0 ] | This function is an alternative to the voltage (and torque) boost obtained through parameter **P-04** (pag. 24).The output voltage is automatically increased as regards the motor and the connected load characteristics. The efficiency of the action depends on the accuracy applied when setting the parameters **P-09, P-11, P-12**. If P-12 parameter is set to zero, the automatic boost does not have any action. OC alarm can be occurred for very fast acceleration and/or deceleration ramps (higher than 50Hz/s). |

## Programmable control inputs

| INPUT TERM. NO. | NAME | FUNCTION | | | | DESCRIPTION |
|---|---|---|---|---|---|---|
| 1 | REV | If **b-00=0** | Run reversal | If **b-00=1** | Backward run | Terminals number 1, 2 and 3 have already factory defined; all the others can be free programmable through **P-39, P-40, P-41, P-42, P-43** parameters.<br>**Note**: Run forward and reverse simultaneously activated (**b-00=1**), have as effect the stop command: reverse rotation is executed when ramp to zero Hz is selected; it will follow the setting of the acceleration ramp. |
| 2 | RUN | | Run | | Forward run | |
| 3 | EXTFLT | Alarm coming from outside | | | | |
| 4 | IN5 | Programmable digital inputs | | | | |
| 17 | IN1 | | | | | |
| 18 | IN2 | | | | | |
| 19 | IN3 | | | | | |
| 20 | IN4 | | | | | |

In the "Name" column is assigned an identification code for each corresponding function.
**P-39, P-40, P-41, P-42, P-43** parameters configuration:

| PARAMETER VALUE | NAME | CONTROL DEFAULT STATE | ACTION PERFORMED | |
|---|---|---|---|---|
| 0 | Ix-RES | Not Active | Resets the alarms ( default function for **P-43** on **IN 5** input) | **NOTE:** If no input is configured to enable (disable) a control, this control is automatically considered as active (inactive) as shown on the column DEFAULT STATE. The x simbol on the Name column must be substituted by thenumber of the input used (usually 4 or 5). |
| 1 | Ix-F1 | " | Reference frequency (as set by **F-xx** (pg. 18)) selectors | |
| 2 | Ix-F2 | " | | |
| 3 | Ix-F3 | " | | |
| 4 | Ix-JOG | " | Jogging control ( default function for **P-42** on **IN 4** input) | |
| 5 | Ix-T1 | " | Acceleration/deceleration ramps selectors (pg. 25) | |
| 6 | Ix-T2 | " | | |
| 7 | Ix-DD | Non Active | Motor output disabling (if enabled, causes a coast-to-stop) | |
| 8 | Ix-DE | Active | Motor output enabling (if disabled, causes a coast-to-stop) | |
| 9 | Ix-ENB | Active | D.C. braking enabling | |
| 10 | Ix-DCB | Not Active | D.C. braking control | |
| 11 | Ix-FLY | Not Active | Enables the motor pickup function in free rotation (flying restart) | |
| 12 | Ix-INC | Active | Enables the function: ramp execution | |
| 13 | Ix-DEC | Not Active | Enables the function: decelerates in ramp up to zero Hz | |
| 14 | Ix-PID | ActiveActive | PID regulator enabling | |
| 15 | Ix-P12 | Not Active | Selector of PID regulator coefficients | |
| 16 | Ix-IM | Not Active | Motorized_potentiometer value increase | |
| 17 | Ix-DM | Not Active | Motorized_potentiometer value decrease | |

**Note:** the last setpoint reference will be storage, when motorpotentiometer function is selected (16 and 17 values)

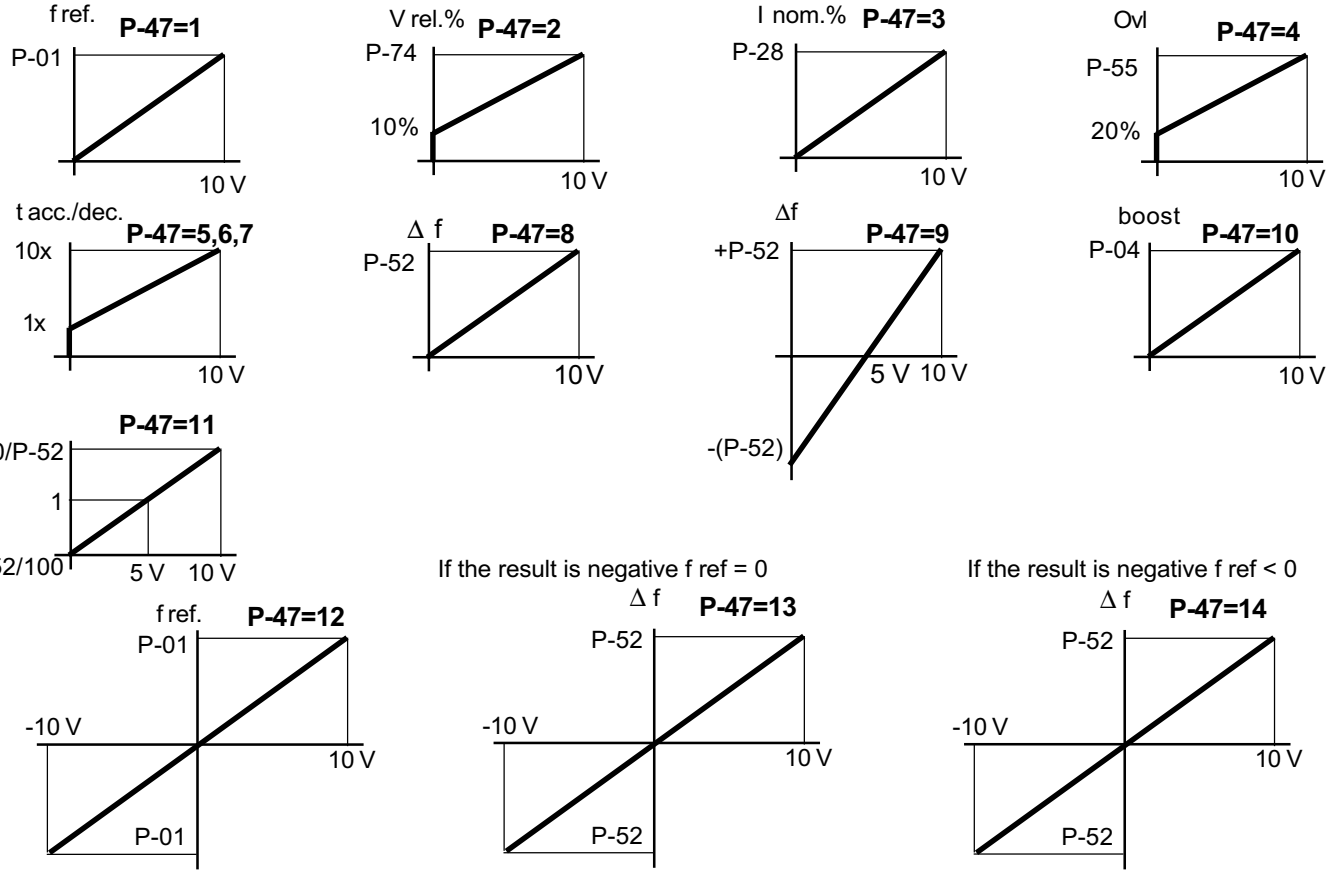
The Associated parameters, corresponding to single controls, are acting through the following actions:

| PARAMETER | FUNCTION | RANGE [DEFAULT] | DESCRIPTION | |
|---|---|---|---|---|
| b-01 | Sets stop condition | 0<br>1 [ 0 ] | The control causes a ramp deceleration up to zero Hz<br>The control cuts off the voltage to the motor so that it coasts-to-stop | |
| b-02 | Enables motor reversal | 0<br>1 [ 1 ] | Disables the control for motor rotation reversal<br>Enables the control for motor rotation reversal | (*) In order to start, the inverter shall detect the switching from the inactive to the active state of the run control. |
| b-03 | Safety | 0<br>1 [ 1 ] | The safety command for run control is disabled<br>Enables the safety command for run control (*) | |
| b-08 | Set the state of external alarm IN | 0<br>1 [ 0 ] | Set the input as normally open (N.O.).The contact closure generates the alarm state<br>Set the input as normally closed (N.C.).The opening generates the alarm state. | |
| b-09 | Set external alarm action | 0<br>1 [ 0 ] | The alarm state caused by EXTFLT locks the inverter (released only through a reset)<br>The alarm state caused by EXTFLT disables the motor as long as the control is active. | |
| b-10 | External alarm detection mode | 0<br>1 [ 0 ] | Allows the inverter to detect the external alarm at any moment<br>Allows the inverter to detect the external alarm only if the motor is running. | |
| b-11 | Extern. alarm reset management | 0<br>1 [ 0 ] | If EXTFLT causes the inverter lock, a manual reset only can be executed<br>If EXTFLT causes the inverter lock, an automatic reset can be executed if **b-12=1.** | |
| b-38 | Inputs filtration | 0<br>1 [ 0 ] | Command is accepted, if its action is higher than 10 ms. Command is accepted, if its action is higher than 5 ms. (Note: noises sensitive can be higher). | |
| b-39 | Term. board control management | 0<br>1 [ 1 ] | Ignores the controls from terminal board (except **EXTFLT**, **Ix-DE**, **Ix-DD**)<br>Enables the control from terminal board. | |
| b-60 | DC braking enabl. at the STOP, by the JOG command | 0<br>1 [ 0 ] | It allows enabling/disabling of DC braking function, when JOG command is released.<br>Jog. | |

## Auxiliary analog input ( AUX-V )

| VALUE P-47 | FUNCTION |
|---|---|
| **0** | No action |
| **1** | Frequency reference (active if **Ix-F1**=on, **Ix-F2**=off, **Ix-F3**=off); the frequency changes in a linear way from 0 Hz to **P-01**. |
| **2** | Adjusts the output voltage reduction by a proportional value ranging between 20% and **P-74.** |
| **3** | Adjusts the braking direct current, whose level proportionally changes between 0 and **P-28**. |
| **4** | It sets the instantaneous overcurrent threshold; this setting will linear change between 20% and P-55 value. |
| **5** | acceleration/deceleration ramp extension factor ; it linear changes between 1 and 10. |
| **6** | acceleration ramp extension factor ; it linear changes between 1 and 10. |
| **7** | deceleration ramp extension factor ; it linear changes between 1 and 10. |
| **8** | positive frequency reference corrections; it will be proportional to a value between 0 and P-52. |
| **9** | frequency reference corrections: it will be proportional to a value between P-52 and P-52. 5V is equal to zero correction. |
| **10** | Adjusts the boost level; the level proportionally changes between 0 and P-04. |
| **11** | Gain of main reference (REF-V) |
| **12** | The function is equal to "1" selection, but with -10V..+10V signal (the sign determines pos/neg rotation) |
| **13** | Frequency reference corrections between -P-52 and P-52 values, with -10V..+10V variable input. If its result is negative, the output speed is limited to zero. |
| **14** | Frequency reference corrections between -P-52 and P-52 values, with -10V..+10V variable input. If its result is negative, the motor rotation is inverted. |

**Note:** The action performed by the analogue signal at terminal 22, depends on the value given to parameter P-47.




If the result is negative f ref = 0







If the result is negative f ref < 0




According to the datas shown in the table, can be defined an offset and a gain for main REF-V and auxiliary AUX-V analog inputs. Those parameters are useful to manage the analog input signals selected for the PID functions.
**P-14** (offset) and **P-15** (gain) parameters are valid only when REF-V are AUX-V are used as speed reference; **P-104**, **P-105**, **P-106** and **P-107** parameters have always effect.

| PARAMETER | DESCRIPTION | RANGE | UNIT | DEFAULT |
|---|---|---|---|---|
| P 104 | Analogue input offset REF V | -9,99 ... +9,99 | 0,01 volt | 0,00 |
| P 105 | Analogue input gain REF V | -9,99 ... +9,99 | 0,01 | 1,00 |
| P 106 | Analogue input offset AUX V | -9,99 ... +9,99 | 0,01 volt | 0,00 |
| P 107 | Analogue input gain AUX V | -9,99 ... +9,99 | 0,01 | 1,00 |

## Analog Output (OUT-AN1 and OUT-AN2 )

| VALUE P-48-P100 | FUNCTION |
|---|---|
| 0 | Signal proportional to the output frequency; full scale value set by P-01 |
| 1 | 10V- amplitude square wave with frequency equal to the output frequency |
| 2 | 10V- amplitude square wave with frequency twice the output frequency |
| 3 | Signal proportional to the output current; the full scale value is twice the rated current |
| 4 | Signal proportional to the output voltage; full scale value set by P-02 |
| 5 | Signal proportional to the output torque (positive only); the full scale value is twice the rated Torque |
| 6 | Signal proportional to the output Torque (absolute value); the sign can be obtained by one of the digital outputs |
| 7 | Signal proportional to the output power (positive only); the full scale value is twice the motor rated power |
| 8 | Signal proportional to output power (absolute value); sign obtainable by one of the digital outputs; the full scalevalue is twice the motor rated power |
| 9 | Signal proportional to the output cos.(positive only); full scale value is 1 |
| 10 | Signal proportional to the output cos. (absolute value); sign obtainable by one of the digital outputs. |
| 11 | Signal proportional to the encoder frequency; the full scale value is set by the value P001 |
| 12 | Signal proportional to reference frequency |
| 13 | Signal proportional to current Iu |
| 14 | Signal proportional to current Iv |
| 15 | Signal proportional to current Iw |
| 16 | Signal proportional to load current Icosφ. |
| 17 | Signal proportional to reactive current Isinφ. |
| 18 | Signal proportional to PID output |
| 19 | Signal proportional to the DC link voltage |
| 20 | Signal proportional to the output frequency with rotation direction (-10V..+10V) |
| 21 | Signal proportional to the output Torque, with sign (-10V..+10V) |
| 22 | Signal proportional to output power, with sign (-10V..+10V) |
| 23 | Signal proportional to the output cos., with sign (-10V..+10V) |
| 24 | Signal proportional to the encoder frequency, with rotation direction (-10V..+10V) |
| 25 | Signal proportional to reference frequency, with rotation direction (-10V..+10V) |
| 26 | Signal proportional to current Iu, with sign (-10V..+10V) |
| 27 | Signal proportional to current Iv, with sign (-10V..+10V) |
| 28 | Signal proportional to current Iw, with sign (-10V..+10V) |
| 29 | Signal proportional to load current Icos., with sign (-10V..+10V) |
| 30 | Signal proportional to reactive current Isin., with sign (-10V..+10V) |

| PARAMETER | FUNCTION | VALUE [DEFAULT] | NOTE |
|---|---|---|---|
| P-49 | Adds a variable offset to the signal chosen by P-48 | - 9,99 / +9,99 [ 0,00 ] ( V ) | The output voltage at terminal N.° 21 of the control terminal board, OUT-AN, can vary between 0 and 10V. The meaning assumed by this voltage depends on the value assigned to parameter **P-48**. The value of the voltage can be changed by properly programming the parameters **P-49, P-50, P-51.** |
| P-50 | Set a gain for the analog output 1 | - 9,99 / +9,99 [ 1,00 ] | |
| P-51 | Change the time constant of the output voltage filter 1 | 0,00 / 2,50 [ 0,00 ] ( s ) | |
| P101 | Adds a variable offset to the signal chosen by P100 | 9,99 / +9,99 [ 0,00 ] ( V ) | The output voltage at terminal N of the control terminal board, OUT-AN, can vary between -10 and 10V. The meaning assumed by this voltage depends on the value assigned to parameter **P100**. The value of the voltage can be changed by properly programming the parameters **P101, P102, P103**. |
| P102 | Set a gain for the analog output 2 | - 9,99 / +9,99 [ 1,00 ] | |
| P103 | Change the time constant of the output voltage filter 2 | 0,00 / 2,50 [ 0,00 ] ( s ) | |

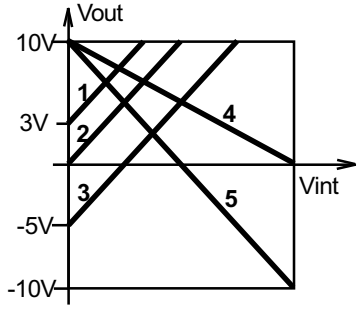
**1:** offset (**P-49**) = 3; gain (**P-50**) = 2
**2:** offset (**P-49**) = 0; gain (**P-50**) = 2
**3:** offset (**P-49**) = -5; gain (**P-50**) = 2
**4:** offset (**P-49**) = 10; gain (**P-50**) = -1
**5:** offset (**P-49**) = 10; gain (**P-50**) = -2

$$Vout = 10 \left[ \frac{Sint}{Sfsc} (\mathbf{P\text{-}50}) \right] + (\mathbf{P\text{-}49})$$

**1:** offset (**P101**) = 3; gain (**P102**) = 2
**2:** offset (**P101**) = 0; gain (**P102**) = 2
**3:** offset (**P101**) = -5; gain (**P102**) = 2
**4:** offset (**P101**) = 10; gain (**P102**) = -1
**5:** offset (**P101**) = 10; gain (**P102**) = -2

$$Vout = 10 \left[ \frac{Sint}{Sfsc} (\mathbf{P102}) \right] + (\mathbf{P101})$$

Sint: internal signal; Sfsc: full scale signal



## Programmable digital outputs - Encoder input

| P-44 VALUE | NAME | DIGITAL OUTPUT DISPLAYED EVENT ( OUTPUT IS ACTIVE ) | | | NOTE |
|---|---|---|---|---|---|
| **0** | Ox-OK | Inverter in ready state | | | The terminal board contains two output type : a)open-collector (**OUT1**, **OUT2**), terminals: **13**, **14**, **15** ; b) relay (**OUT3**) terminals.: **34**, **35**, **36**; the outputs can be configured through parameters as follows: **P-44** configures **OUT1** **P-45** configures **OUT2** **P-46** configures **OUT3** **The outputs are active when the event shown on the table occurs.** **(*) Means that during startup outputs are inactive:** the outputs will be active not before that the PID regulator error come into the tolerance limits at least once. The " x " in the " Name "column indicates the selected output number. |
| **1** | Ox-AL | Inverter in alarm state | | | |
| **2** | Ox-RUN | Motor is running | | | |
| **3** | Ox-STP | Motor is not running | | | |
| **4** | Ox-REV | Counter-clockwise rotation (in the opposite case, the output is not active) | | | |
| **5** | Ox-STD | Inverter in steady state (end of ramp) | | | |
| **6** | Ox-RMP | Ramp in progress | | | |
| **7** | Ox-EQF | The output frequency **=** to programmed frequency **P-53,** with hysteresis **P-54** | | | |
| **8** | Ox-NEF | The output frequency **≠** to programmed frequency **P-53**, with hysteresis **P-54** | | | |
| **9** | Ox-GTF | The output frequency **>** than " " " **P-53**, with hysteresis **P-54** | | | |
| **10** | Ox-LTF | The output frequency **<** than " " " **P-53**, with hysteresis **P-54** | | | |
| **11** | Ox-RN1 | Ramp end (disabled when the output freq. is **<** than programmed freq. **P-53**) | | | |
| **12** | Ox-RN2 | Output frequency **<** than programmed frequency **P-53** (disabled at ramp end) | | | |
| **13** | Ox-UV | Undervoltage with running motor (not depends from short mains blackout) | | | |
| **14** | Ox-GTT | Output torque **>** than the torque set by **P-55** (and **AUX-V**,if enabled) | | | |
| **15** | Ox-IL | In case of ramps extension for limitation of : | | current | |
| **16** | Ox-VL | | | voltage | |
| **17** | Ox-IVL | | | current or voltage | |
| **18** | Ox-FLY | When the motor pickup occurs | | | |
| **19** | Ox-BRK | The dynamic braking circuit is faulty | | | |
| **20** | Ox-CFI | The cos φ sign is negative | | | |
| **21** | Ox-ERP | The PID regulator error is : | >(**P-91**) and < -(**P-92**) | expressed in % of full scale | |
| **22** | Ox-EPP | | > (**P-91**) | | |
| **23** | Ox-EPN | | <-(**P-92**) | | |
| **24** | Ox-ERP(*) | The PID regulator error is : | >(**P-91**) and < -(**P-92**) | expressed in % of full scale | |
| **25** | Ox-EPP(*) | | > (**P-91**) | | |
| **26** | Ox-EPN(*) | | <-(**P-92**) | | |
| **27** | Ox-ERV | Counterclockwise encoder rotation; (clockwise rotation **=** output is inactive) | | | |
| **28** | Ox-EFW | Clockwise encoder rotation; (counterclockwise rotation **=** output is inactive) | | | |
| **29** | Ox-EST | Encoder is stopped | | | |
| **30** | Ox-ERN | Encoder is running | | | |
| **31** | Ox-EF | Signals the intervention of external alarm | | | |
| **32** | Ox-EFN | A logic negation of value on output **31** | | | |
| **33** | Ox-SIU | Signals the current sign of phase U | | | |
| **34** | Ox-SIV | Signals the current sign of phase V | | | |
| **35** | Ox-SIW | Signals the current sign of phase W | | | |
| **36** | Ox-EQT | Programming not available | | | |
| **37** | Ox-NET | Programming not available | | | |
| **38** | Ox-GTT | Programming not available | | | |
| **39** | Ox-LTT | Programming not available | | | |

| | | | |
|---|---|---|---|
| b-57 | Alarm relay logic configuration | 0 = off - 1 = on [ 0 ] | This parameter defines the logic of the alarm relay; default setting |

| PARAMETER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| b-21 | Frequency measurement | 0 = off - 1 = on [ 0 ] | With the optional board, an encoder or a general frequency signal can be used as frequency reference or speed feedback.; **b-22=1** allows the use of encoder with two channels. In this way, the number of the detected pulses is multiplied by 4 (the accuracy increases) and the rotation direction is detected too. The direction can be reversed through the REV control on the terminal board (the choice will have effect only if the change occurs when **b-21=1)**. The input for a one-channel encoder, or another frequency transducer (e.g. phonic wheel), is through channel A terminal. **b-23=1** set the f-encoder as initial frequency during the free rotation motor pickup. **P-59** Set the pulses count time; it affects both the measure accuracy and its update speed. At the maximum speed, **P-59** should be set to such a value that **the number of pulses counted does not exceed 65536**. If both channels are used, the number of pulses counted is 4 times the one detected on one channel only.. (The value selected would be active only if **b-21=1**). P-60 is equal to the encoder ppr devided by the number of motor pole pairs. |
| b-22 | Select double or single input | 0 =single - 1 = double [ 0 ] | |
| b-23 | Allows use of f-encoder | 0 = off - 1 = on [ 0 ] | |
| P-59 | Sets the pulses count time | 0,0(=0,01)-25,0 [ 1 ] ( s ) | |
| P-60 | Encoder pulses per polar pairs. | 1 - 9999 [ 100 ] | |
| P-61 | Correction factor for **P-60** | 0,01 - 99,99 [ 1,00 ] | |

**Note:** If the count time set in P-59 exceeds one second, the resolution will be one second, even if the value shown on the display indicates the tenths too. The encoder frequency is:

$$\textbf{f-encoder} = \text{N-imp} * \frac{1}{(\textbf{P-59}) * (\textbf{P-60}) * (\textbf{P61})} * \text{Cm}$$

N-imp = pulses calculated in time **P-59** → displayed on: **d-19**
Cm = 1 if **b-22=0**
Cm = 1/4 if **b-22=1**

The accuracy of f-encoder depends on the number of counted pulses: its value is 1/N-imp. At low speed, the accuracy could be reduced.
Setting **P-00=5** the **f-encoder** can be used as frequency reference**,** or as reference or feedback input of PID regulator.
The f-encoder value is on the display at position **d-20** as frequency and at **d-21** as speed. As 0/10 V analog signal, the f-encoder value is available on the terminal board by presetting the corresponding analog output: **P-48** or **P100=11** (page 34)**.**
The terminal board can signal the following: encoder rotation direction (in positive or negative logic), encoder stopped (no pulse during the **P-59** time) or in rotation state, through digital output configuration.

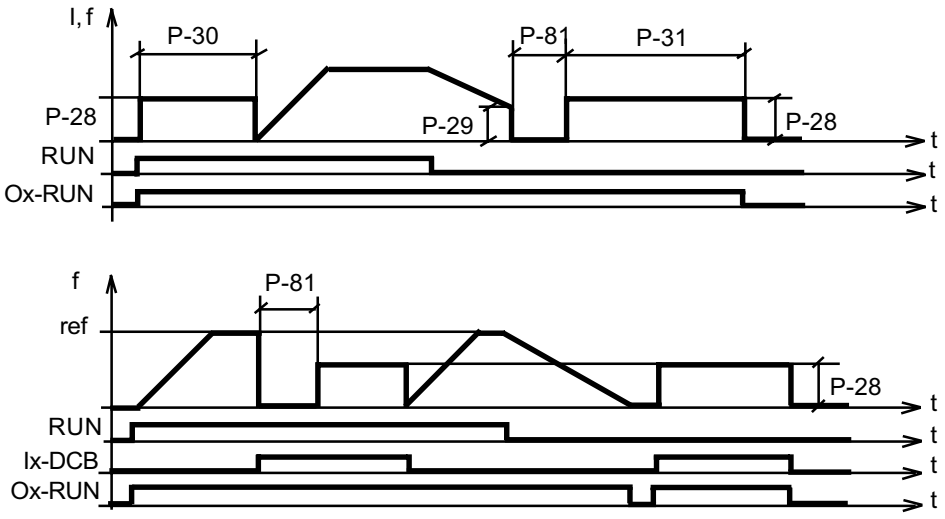
**- Encoder power supply.**
The inverter provides two voltages : +5V (pin 30) and +24V (pin 6). The inverter with encoder option, by default, can accept encoder with a 24V power supply; if the encoder to be used is a 5V unit, and this is declared on the order, it is possible to predispose the inverter at the factory; otherwise: open the inverter, on the circuit board FOX-ENC identify the two microswitch, they are positioned toward the lower side (+24V); to use a 5V encoder they must be positioned toward the upper side.

**Dynamic braking - Direct current braking**

| PARAMETER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| b-20 | Thermic protection of the braking resistor | 0 = off 1 = on [ 0 ] | **b-20=1** enable the thermic protection of the braking resistor**.** The protection efficiency depends on the accuracy of parameters **P-62, P-63, P-64.** The protection level reached can be displayed through parameter **d-11**,expressed in %. When the level reaches 100%, the protection locks the inverter.<br>During the braking phase, in case of shortcircuit of the inner braking device, the corresponding signalling can be displayed through terminal board by properly configuring the **Ox-BRK** output. The only action to be performed in case of shortcircuit is to cut the inverter supply off.<br>**NOTE: The wiring terminals of the braking resistor are NOT short circuit PROTECTED or protected by improper value (lower than minimum expected) of the resistors used : in these cases the inverter will be permanently damaged.** |
| P-62 | Ohmic value of the braking resistor (Ω) | 1 - 250 [ (**) ] | |
| P-63 | Resistance power of the braking resistor (W) | 10 - 250,0 [ (**) ] | |
| P-64 | Thermic constant of the braking resistor (s) | 5 - 1250 [ (**) ] | |

**[ (**) ] = The default values of the parameters depends on the inverter size**.

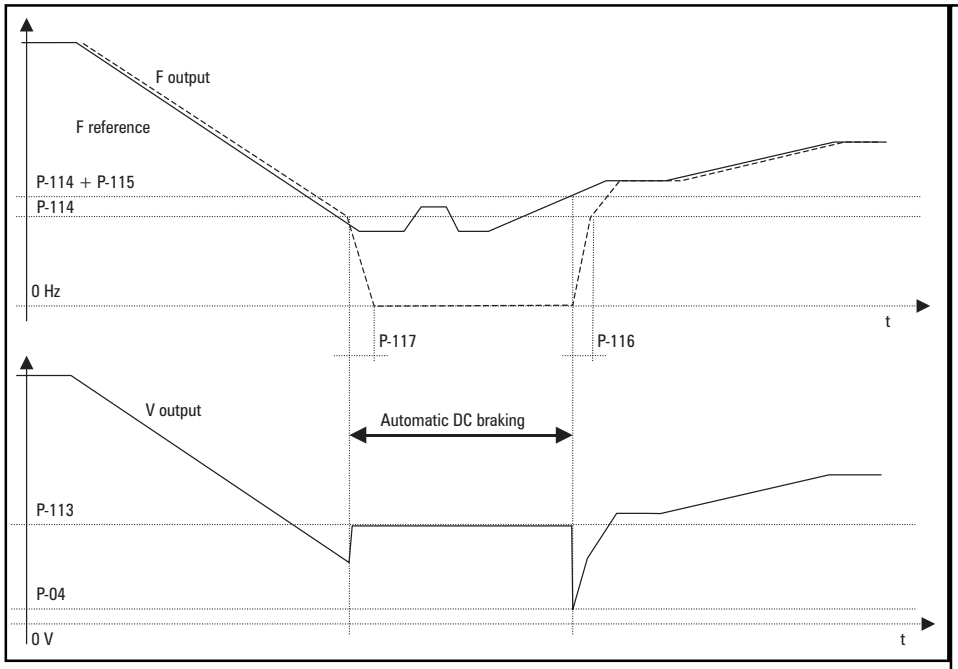
| PARAMETER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| P-28 | D. C. braking level (% of P-09) | 0 - 100 [ 0 ] | Defines the D.C. value expressed in % of **P-02** from which the value of the braking current depends. |
| P-29 | Limit frequency below which the braking is forced (Hz) | 0,0 /500,0 [ 0,0 ] | Defines the frequency below which the deceleration ramp is locked and the braking current is forced. Before forcing the current, Vout is set to zero for a time defined by parameter **P-81** (demag. time). |
| P-30 | Set the braking duration at startup (s) | 0,0 / 60,0 [ 0,0 ] | Defines the braking duration at startup; if **P-30 = 0** → no braking is made at startup. |
| P-31 | Set the braking duration in stop phase (s) | 0,0 / 60,0 [ 0,0 ] | Determines the braking duration in stop phase; if **P-31 = 0** → no braking is made in stop phase. |
| b-60 | DC braking enabling | 0 - 1 [0] | Enabling of DC braking when Jog command is released. |




The aim of D.C. braking is to keep the motor locked in a fixed position, it is not an alternative to the ramp deceleration. The D.C. braking consist in forcing a direct current that depends from the voltage set by **P-28** and the electrical characteristics of the motor into a motor phase (ph. U).
With D.C. braking, the deceleration time is shorter than in case of coast to stop. Sometime, at startup, it mai be useful to lock the motor for a preset time before starting the acceleration ramp.
The braking current intensity can also be adjusted through the terminal board by means of a 0/10V signal applied to the **AUX-V** input (configured with **P-47=3**): the current value changes proportionally to the 0/10V signal between 0 and the value fixed through parameter **P-28**.
The function can also be enabled or disabled through terminal board by configuring one of the programmable inputs (**Ix-ENB**) as a control. It is always possible to force a direct current on the motor, independently of the values assumed by the parameters, by configuring one of the terminal board programable inputs (**Ix-DCB**) as control of for D.C. braking.
During the D.C. braking, at parameter **d-00** the display shows the message " **dcb** " instead of the frequency.

## Automatic direct current Braking

| PARA METER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| b-68 | automatic DC braking enabling | 0 / 1 [ 0 ] | 0 = disabled<br>1 = enabled |
| P-113 | automatic DC braking level | 0 - 100%P02 [ 0 ] | Automatic DC braking level (%of P02), according to P-114 |
| P-114 | automatic DC braking frequency enabling (Hz) | 0,0 / 50,0 [ 0,0 ] | When the frequency level goes below the threshold sets P-114 parameter, the output frequency is automatically forced to 0Hz. |
| P-115 | Hysterisis of P114 parameter | 0,1 /25,0 [ 0,1] | Hysterisis of P114 [Hz] |
| P-116 | acceleration time of DC braking output | 0,1 / 25,0 [ 0,1 ] | Output frequency acceleration time from 0 Hz to the frequency threshold set with P114. |
| P-117 | deceleration time of DC braking input | 0,1/ 25,0 [0,1 ] | Output frequency deceleration time from the frequency threshold sets with P114 to 0 Hz. |




When the frequency reference (and output) decrease under a value sets with P-114, the output frequency is automatically sets to 0 Hz, following P-117 ramp time; contemporary the output voltage is automatically sets to a value equal P113 (% of P02).
Therefore the inverter gives a DC current to the motor with an effect similar to the DC brake programmed at the start, with the difference that in this case its control is automatically managed following the output frequency behavior.
The DC current effect remain active until the frequency reference do not return to a value higher than P-114 (with hysterisis equal to P-115): at this point the DC current effect will be cut and the output frequency will return to the value sets with P-114, following P-116 ramp time; than the frequency set will reach following the standard acceleration ramp time.

If at the START command the frequency reference is higher than P-114, it is normally active the standard acceleration ramp time: other ways the automatic DC brake becomes active.
If at the STOP command the frequency reference (and output) is above P-114 value, it is normally active the standard deceleration ramp time: other ways if the output frequency is 0 Hz, the STOP command becomes immediately active.

### PID regulator

| PARA METER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| b-40 | PID regulator enabling | 0 = off 1 = on [ 0 ] | The regulator is active with running motor only. |
| b-41 | Disables the regulator in ramp phase | 0=off 1=off [ 0 ] | 1 interrupts the regulator action during the ramp phase. |

## PID regulator

| PARAMETER | FUNCTION | VALUE [DEFAULT] | ACTION PERFORMED |
|---|---|---|---|
| b-42 | Allows regulator updating period to be locked to the encoder | 0 = off 1 = on [ 0 ] | When the encoder is used as reference or feedback signal **b-42** allows updating period of the regulator output to be locked to the encoder one (**P-59**). |
| b-43 | Select the controlled parameter | 0=frequency 1=voltage [ 0 ] | **0:** the regulator controls the output frequency; full scale value defined by **P-01**; **1:** controls the output voltage; full scale value defined by **P-02**; |
| b-44 | Reverts the error signal sign | 0 = off 1 = on [ 0 ] | The sign of the error signal between reference and feedback is reversed (and the adjustment effect too). |
| b-45 | Modality of control | 0=direct 1=(feed/forward) [ 0 ] | **1:**the reg. output is added to the freq. reference value or to the voltage value provided by the V/F characteristic; **0:** the output act as set by **b-43**. |
| b-46 | Suppress the regulator positive output | 0 = off 1 = on [ 0 ] | Limits the regulator output in the positive direction; **0** allows the output to assume positive values too. |
| b-47 | Suppress the regulator negative output | 0 = off 1 = on [ 0 ] | Limits the regulator output in the negative direction; **0** allows the output to assume negative values too. |
| b-48 | Suppress the integral term | 0 = off 1 = on [ 0 ] | Allows for integral term to match the limits set to the output by **b-46** and **b-47.** |
| b-49 | Initialisation of the integral term at startup | 0 = off 1 = on [ 0 ] | Allows the initialization by means of the run control. **NOTE:** this could cause a very slow response of the regulator, even with high gains. |
| b-63 | PID reverse rotation enabling | 0 = off 1 = on [ 0 ] | When it is equal 0, the rotation does not change if the PID output is negative. When it is equal 1, the rotation changes direction if the PID output is negative. |
| b-65 | Input selection for PID derivative part | 0 = off 1 = on [ 0 ] | When it is equal 0, the PID derivative part calculation is based on the error. When it is equal 1, the PID derivative part calculation is based on the feedback. |
| P-90 | PID regulator reference (%) | 0,1 - 100,0 [ 5,0 ] | The reference value is derived through the setting of the selector parameters shown on the following table. |
| P-91 | PID maximum positive error (%) | 0,0 - 100,0 [ 0,0 ] | Defines the max. positive excursion of the regulator error expressed in % of the full scale value. |
| P-92 | PID maximum negative error (%) | 0,1 - 100,0 [ 5,0 ] | Defines the max. negative excursion of the regulator error expressed in % of the full scale value |
| P-93 | PID regulator update time (s) | 0,00(=0,005s) - 2,50 [ 0,00 ] | Defines the regulator update time. |
| P-94 | Proportional term gain - **Kp1** | 0,00 - 99,99 [ 0,00 ] | set N. 1 |
| P-95 | Integral action time - **Ti1** | 0,00 - 99,99 [ 99,99 ] | set N. 1 |
| P-96 | Derivative action time - **Td1** | 0,00 - 99,99 [ 0,00 ] | set N. 1 |
| P-97 | Proportional term gain - **Kp2** | 0,00 - 99,99 [0,00 ] | set N. 2 |
| P-98 | Integral action time - **Ti2** | 0,00 - 99,99 [99,99] | set N. 2 |
| P-99 | Derivative action time - **Td2** | 0,00 - 99,99 [ 0,00 | set N. 2 |

The regulator enabling and the coefficients selection can be made through terminal control board by configuring two out of the five control inputs as **Ix-PID** and **Ix-P12** input respectively:
**Ix-PID = 1** the PID regulator is controlled from the terminal board.
**Ix-P12 = 1** selects the coefficient set N. 1; **0** refers to set 2.
When enabling the regulator or changing the coefficients set, the integral term is used according to the present output and coefficients, by taking into account possible limits applied to the output and to the integral term; this avoid sudden output changes ("bumpless" operation).
If the coefficient change occurs when the error is significant, the system response speed is affected by the integral action weight, as the proportional and derivative term weight is compensated by the integral term.
A max. tolerance interval can be defined for the error that, if exceeded, actuates a signalling available on the terminal board by properly configuring one of the digital outputs: **OUT1, OUT2, OUT3 .**
The error tolerance control is enabled when the error falls within the preset interval for the first time (**P-44** value: 21, or 22, or 23). During startup transient (that is: not before the regulator error falls within the tolerance limits at least once), it is possible to disable the outputs through **P-44** value 24, or 25, or 26. The possible sign reversal made by setting **b-44=1** has no importance for tolerance control.
The out-of-tolerance signaling available on the digital outputs can be enabled when exceeding one of the two limits (**Ox-ERP**), or the positive (**Ox-EPP**) or negative (**Ox-EPN**) limit only.
To facilitate the parameters setting, the following items can be displayed:

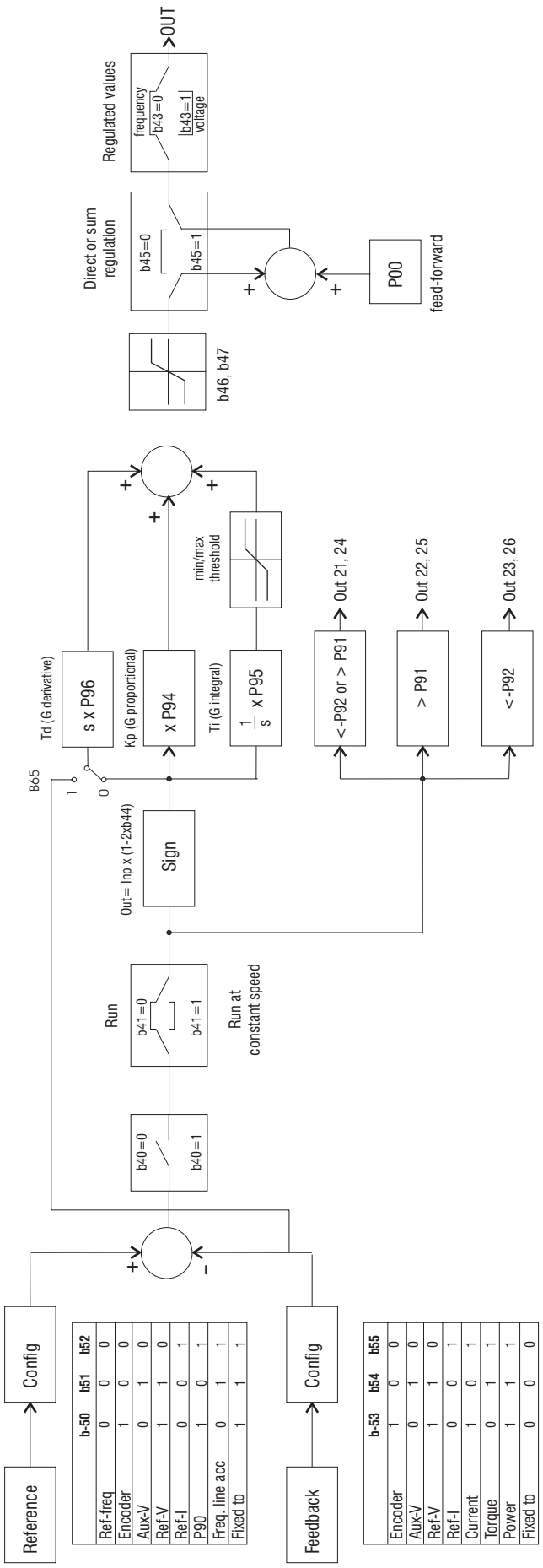
reference signal: code **d-22** on display,
feedback signal: code **d-23,** "
error: code **d-24**, "
integral component: code **d-25**, "
output: code **d-26,** "

**NOTE:** The integral term is set to zero if the integral action time is set to the max. value, i.e. 99.99. The derivative term is null if the derivative action time is set to zero.

]

| | feedback switches b-55 | b-54 | b-53 |
|---|---|---|---|
| fixed at 0 | 0 | 0 | 0 |
| freq. from encoder input | 0 | 0 | 1 |
| AUX-V | 0 | 1 | 0 |
| REF-V | 0 | 1 | 1 |
| REF-I | 1 | 0 | 0 |
| Iout (10V=2*Inom) | 1 | 0 | 1 |
| Tout (10V=2*Tnom) | 1 | 1 | 0 |
| Pout (10V=2*Pnom) | 1 | 1 | 1 |

| | reference switches b-52 | b-51 | b-50 |
|---|---|---|---|
| reference frequency | 0 | 0 | 0 |
| freq. from encoder input | 0 | 0 | 1 |
| AUX-V | 0 | 1 | 0 |
| REF-V | 0 | 1 | 1 |
| REF-I | 1 | 0 | 0 |
| **P-90** in % of full scale | 1 | 0 | 1 |
| freq. downstream ramp gener. | 1 | 1 | 0 |
| fixed at 0 | 1 | 1 | 1 |


OUT
Regulated values
frequency
b43=0
b43=1
voltage
Direct or sum
regulation
b45=0
b45=1
P00
feed-forward
b46, b47
min/max
threshold
Td (G derivative)
S x P96
Kp (G proportional)
x P94
Ti (G integral)
1/s x P95
<-P92 or > P91
Out 21, 24
> P91
Out 22, 25
<-P92
Out 23, 26
B65
1
0
Out= Inp x (1-2xb44)
Sign
Run
b41=0
b41=1
Run at
constant speed
b40=0
b40=1
Reference
Config
Feedback
Config
b-50 b51 b52
Ref-freq 0 0 0
Encoder 1 0 0
Aux-V 0 1 0
Ref-V 1 1 0
Ref-I 0 0 1
P90 1 0 1
Freq. line acc 0 1 1
Fixed to 1 1 1
b-53 b54 b55
Encoder 1 0 0
Aux-V 0 1 0
Ref-V 1 1 0
Ref-I 0 0 1
Current 1 0 1
Torque 0 1 1
Power 1 1 1
Fixed to 0 0 0

## Reset - Autoreset - Protections and alarms

| FUNCTION | DESCRIPTION |
|---|---|
| **Reset** | Operation to be executed when the inverter is in alarm state. Three possibilities are available:<br>a) Keyboard reset:<br>simultaneously press the ⇑ and ⇓ keys : the action will have effect when the keys are released.<br>b) Terminal board reset:<br>it can only be performed if one of the programmable control inputs has been configured as **Ix-RES**. In this case, the reset operation is enabled when switching from active to inactive control.<br>c) Cut the inverter supply off, wait until it is completely off, supply the inverter again. |
| **Autoreset** | As an alternative to manual reset, this function allows an automatic restart in case of lock due to protection tripping. It can only be enabled if the lock is due to: overcurrent, overvoltage, undervoltage, momentary overload, external alarm (**b-11**) and is controlled by the parameters defined on the following table: |

| PARAMETER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| b - 12 | Autoreset enabling | 0 = off 1 = on [ 0 ] | In case of lock, it automatically restarts the inverter. |
| b - 13 | Enable autoreset attempts limitation | 0 = off 1 = on [ 0 ] | Allows for limiting the number of attempts made by the inverter to execute the autoreset. |
| b - 14 | Enable the automatic set at zero the number of attempts | 0 = off 1 = on (10 min.) [ 0 ] | Sets to zero the number of attempts performed, if no further locks occur within 10 min. |
| b - 15 | Set the state of the alarm contact during the autoreset. | 0 = off 1 = on [ 1 ] | During autoreset, it disables the lock signalling contacts on the terminal board if allowed, through parameter setting, to perform the alarm function. |
| P - 57 | Delay to start the autoreset function (s) | 0,1 - 60,0 [ 5 ] | Defines the time, as regards the lock enabling moment, after which the autoreset (restart) is executed. |
| P - 58 | Set the max. number of restart attempts | 1 - 250 [ 1 ] | Sets the max. number of restart attempts after which the inverter remains in lock state. To restart, execute a manual reset. |

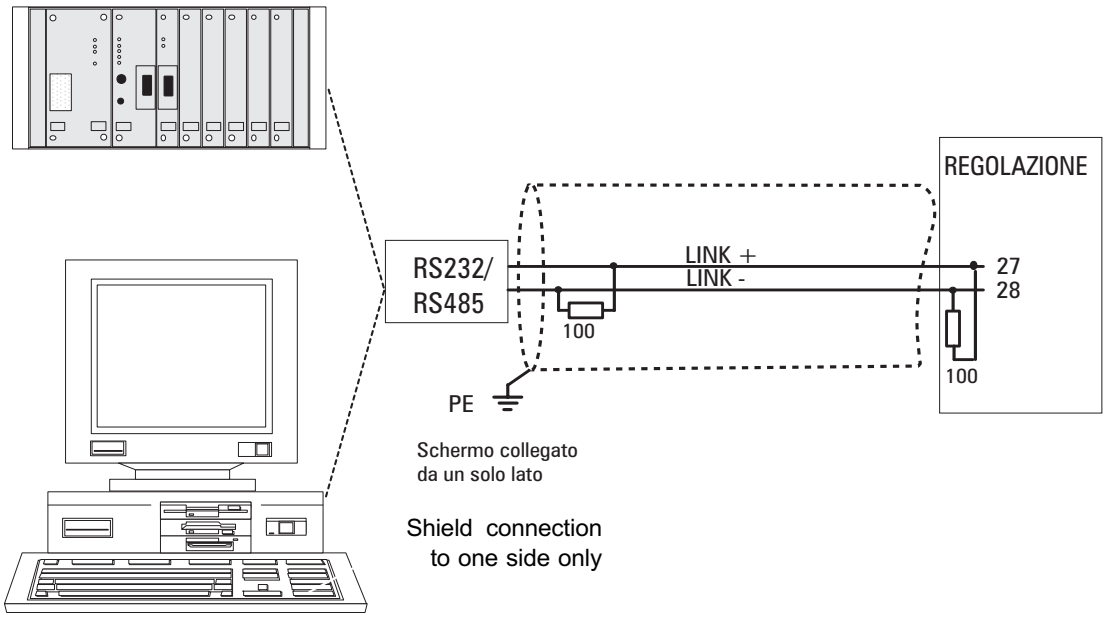
| CODE ON DISPLAY | FUNCTION | DESCRIPTION | CODE |
|---|---|---|---|
| C .Err | **Full lock** (alarm contact enabled) | Configuration memory error. It is enabled at inverter startup if the configuration memory is not working properly. To avoid this, try to turn the inverter off and restart it after some minutes. | |
| P .Err | | Parameter memory error. It is enabled if the memory contains inconsistent parameters. Causes: accidental loss of parameters (turning off during storage phase), memory failure. In case of accidental loss: turn the inverter off and restart it after some minutes. The factory-preset parameters will be stored. | |
| FU | | Fuse breakage protection: enabled in case of inner fuse breakage. Autoreset is not allowed. | 11 |
| S - OH | | Heatsink temperature sensor damaging. | 13 |
| EF | **Lock that can be reset** ( alarm contact enabling and storage of alarm type, the display is flashing) | External protection: enabled by the EXTFLT input on terminal board. Autoreset can be enabled only if parameter **b-11=1.** | 1 |
| OC | | Overcurrent protection: enabled when the output current exceeds, even momentary, the max. allowed threshold to protect the inverter. It signals shortcircuits between phases and to ground too. | 2 |
| OU | | Overvoltage protection: enabled when the voltage at the filter capacitor ends exceeds the max. programmed threshold to protect the inverter. | 3 |
| UU | | Undervoltage protection: enabled when the voltage at the filter capacitor ends falls below the min. threshold programmed to avoid troubles due to torque reduction. Autoreset is allowed. If **b-37=0**, the alarm storage is disabled. | 4 |
| OH | | Overtemperature protection: enabled when the heat sink temperature exceeds the max. threshold programmed to protect the inverter. Autoreset is not allowed. | 5 |
| OL1 | | Inverter overload protection: enabled when the direct current exceeds the max. threshold for the max. allowed time (**IxT**) to protect the inverter. Autoreset is not allowed. | 6 |
| OLM | | Motor overload protection: enabled when the direct current exceeds the max. threshold for the max. allowed time ($\mathbf{I^2xT}$), to protect the motor. The levels and times depend on setting of the motor characteristic data. Autoreset is not allowed. | 7 |
| OLr | | Braking resistor overload protection: enabled when the power dissipated by the braking resistor exceeds the max. threshold for the max. allowed time. The levels and times depend on setting of the resistor characteristic. Autoreset is not allowed. | 8 |
| Ot | | Protection for momentary motor overload: it is active, after enabling (**b-17=1**), when the torque delivered by the motor exceeds the programmed level for the preset time, to protect the connected mechanical parts or the worked material. | 9 |
| PH | | Protection for supply phase lack (valid for 3-phase supply only): enabled 30 s. after one of the supply phases has been disconnected. Autoreset is not allowed. | 10 |
| OCH | | Overcurrent protection: it is active (as alternative of OC) for high peaks of current or short-circuit. | 12 |
| OHc | | Overcurrent protection: it is active (as alternative of OC) for high peaks of current or short-circuit | 14 |

**RS 485 SERIAL INTERFACE**

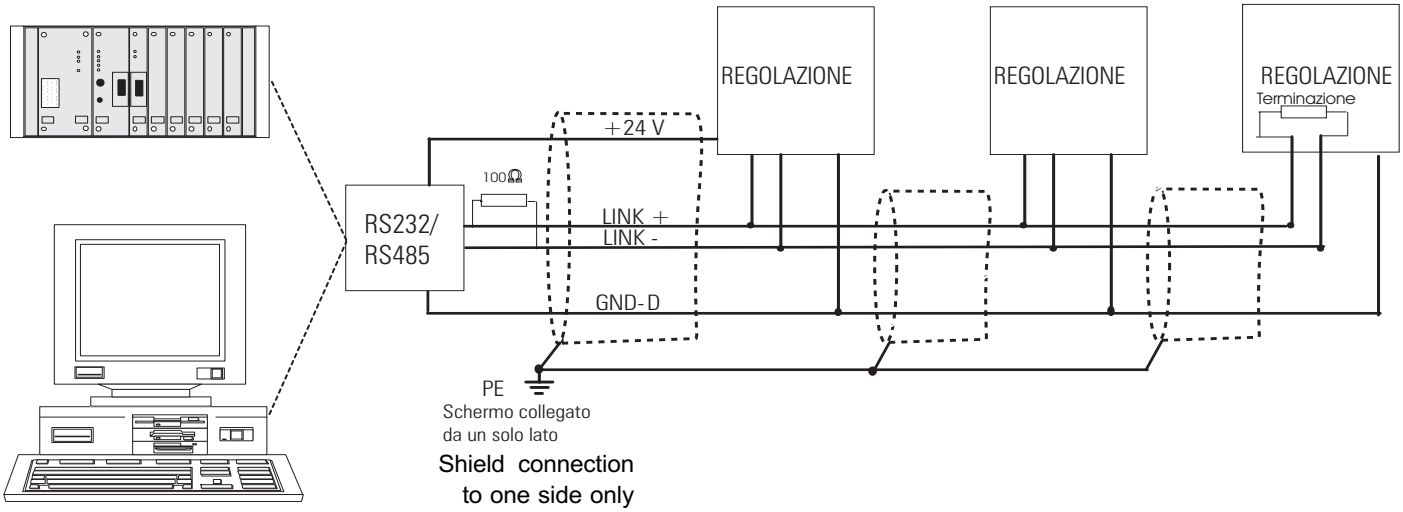
The RS 485 serial line allows the data transmission through a loop made of two symmetrical conductors, which are twisted with a common shield. The RS 485 serial line is available on 27 and 28 (LINK+ and LINK-) of the regulation drive terminals.
The resistor terminations determined by J13 jumper: not inserted termination not available; inserted termination available.
For a correct serial line connection make sure that:
- shielded cables have used
- power cables and controlling board cables are located into different pundits
- the termination is inserted to the bus extremities

Available as option it is possible an opto-coupled serial line, which guarantee a reliable serial communication.
The J2 group of jumpers, near 31-32 terminals of the regulation board, are defaulted set to provide an internal supply for the serial line, which is not opto-coupled. ;.
In case of it is necessary to have an opto-coupled serial line, J2 group of jumpers need to be set correctly and an external +5V supply source need to be provide to the 29-30 regulation board terminals.

SINGLE CONNECTION




MULTIDROP CONNECTION



**Serial line**

| PARAME-TER | FUNCTION | VALUE [DEFAULT] | DESCRIPTION |
|---|---|---|---|
| P-65 | Enables the control of inputs from serial line | 0 - 255 [ 0 ] | The parametrer value is a decimal equivalent of the current value of the 8 bit input register **SX8** (see the serial comunication handbook) |
| P-66 | Enables the control of outputs from serial line | 0 - 15 [ 0 ] | The parametrer value is a decimal equivalent of the current value of the 8 bit ooutput register **SX8** (see the serial comunication handbook) |
| P-67 | Defines the transmission parameters | 0 - 19 [ 1 ] | See the following table |
| P-68 | Assign an address to each inverter | 0 - 99 [ 0 ] | Assign the unique address between 0 - 99 to each inverter |
| P-69 | Set the response delay time of the inverter | 0 - 250 [ 1 ] ( ms ) | The delay time between the receipt of the comand and the emission of the answer |
| P-89 | Serial link time-out | 0.0 - 25 sec. [ 0,0; disabl.] | Time-out answer time |
| b-39 | Enables the terminal board control | 0 = off 1 = on [ 0 ] | The scope of the parameter is to disable the control of the inverter from the terminal board to avoid conflicts with the serial line. |
| b-58 | It defines the termination character of the Quixlink word. | 0 = off 1 = on [ 0 ] | It allows to insert, when desired, the termination character of the Quixlink word. |

The serial line of FOXM inverter series can communicate through a proprietary protocol named Foxlink (see details on page44) or with standard Modbus protocol. The **P-67** parameters allows the setting of serial line protocol type.

| Value of P-67 | Protocol | Baudrate | Data bit | Parity | Stop bit |
|---|---|---|---|---|---|
| 0 | Foxlink | 9600 | 7 | Even | 1 |
| 1 | Foxlink | 9600 | 7 | Odd | 1 |
| 2 | Foxlink | 9600 | 7 | None | 2 |
| 3 | Foxlink | 9600 | 8 | None | 1 |
| 4 | Foxlink | 4800 | 7 | Even | 1 |
| 5 | Foxlink | 4800 | 7 | Odd | 1 |
| 6 | Foxlink | 4800 | 7 | None | 2 |
| 7 | Foxlink | 4800 | 8 | None | 1 |
| 8 | Foxlink | 2400 | 7 | Even | 1 |
| 9 | Foxlink | 2400 | 7 | Odd | 1 |
| 10 | Foxlink | 2400 | 7 | None | 2 |
| 11 | Foxlink | 2400 | 8 | None | 1 |
| 12 | Foxlink | 1200 | 7 | Even | 1 |
| 13 | Foxlink | 1200 | 7 | Odd | 1 |
| 14 | Foxlink | 1200 | 7 | None | 2 |
| 15 | Foxlink | 1200 | 8 | None | 1 |
| 16 | Foxlink | 19200 | 7 | Even | 1 |
| 17 | Foxlink | 19200 | 7 | Odd | 1 |
| 18 | Foxlink | 19200 | 7 | None | 2 |
| 19 | Foxlink | 19200 | 8 | None | 1 |
| 20 | Modbus | 9600 | 8 | None | 1 |
| 21 | Modbus | 4800 | 8 | None | 1 |
| 22 | Modbus | 2400 | 8 | None | 1 |
| 23 | Modbus | 1200 | 8 | None | 1 |
| 24 | Modbus | 19200 | 8 | None | 1 |
| 25 | Jbus | 9600 | 8 | None | 1 |
| 26 | Jbus | 4800 | 8 | None | 1 |
| 27 | Jbus | 2400 | 8 | None | 1 |
| 28 | Jbus | 1200 | 8 | None | 1 |
| 29 | Jbus | 19200 | 8 | None | 1 |

The proprietary protocol specifications are provided below, while reference is made to the Modbus manual for instructions in respect of that protocol.
All transmitted characters are **7 bit ASCII characters**.
The values are integers in decimal notation; the units are relative to the full scale forecast resolution, except different indications, (see manual).

The general **transmission string** is:

**<EOT>, <HAD>, <HAD>, <LAD>, <LAD>, <STX>, X, x,x,=,n,...,n, <ETX>, <CKS>,<CR>** **(*)**

initial code — inverter address — data start — DATA — data end — control code — ending character

where:

**<EOT>** = **04Hex**
**<STX>** = **02Hex**
**<ETX>** = **03Hex**
**<ACK>** = **06Hex**
**<NAK>** = **15Hex**
**<HAD>** = most significant digit of inverter address
**<LAD>** = least significant digit of inverter address
**<CKS>** = **XOR** of characters between **<STX>** and **<ETX>** ( eventually added to 20H if XOR is less than 20H)
**<CR>** = **0DHex (13)** ending character for all strings **(*)** (**software version 1.13 and subsequent**)
**X** = is the parameter involved in the transmission
**x,x** = numerical code of the interested item relative to the parameter involved
**n,...,n** = actual value of the interested item when it is read or write.

The editing of an out range parameter occurred as error the message " E" (command not accepted).

<table>
<tr><th>FUNCTIONS</th><th>To read</th><th>To write</th><th>Answer</th></tr>
<tr><td>Display Reading</td><td>...,<STX>, D, x,x, <ETX>,...</td><td></td><td>command accepted :<br><STX>, D, x,x,=,n,...,n, <ETX>, <CKS>,<CR> (*)<br>command not accepted :<br><STX>, E, <ETX>, <CKS>,<CR> (*)<br>reception not correct:<br><NAK>,<CR> (*)</td></tr>
<tr><td colspan="4">Note:<br>The values related to d-00, d-01, d-20, are expressed in 0.01 Hz; those related to d-05, d-06, d-21 in 0,01;<br>For the codes related to alarm memories d-12, d-13, d-14, d-15, you can see the inverter handbook.<br>The values related a d-16, d-17, d-18, are decimal equivalents of the binary code seen on the display.<br>The value related to d-29, is the decimal equivalent of the hexadecimal code seen on the display.<br>It is not possible read d-30.</td></tr>
<tr><td rowspan="2">F-xx Parameters</td><td>...,<STX>, F, x,x, <ETX>,...</td><td></td><td>command accepted :<br><STX>, F, x,x,=,n,...,n, <ETX>, <CKS>,<CR> (*)<br>command not accepted :<br><STX>, E, <ETX>, <CKS>,<CR><br>reception not correct : (*)<br><NAK>,<CR> (*)</td></tr>
<tr><td></td><td>..,<STX>,F,x,x,=,n,...,n,<ETX>,..</td><td>command accepted :<br><ACK>,<CR> (*)<br>command not accepted :<br><STX>, E, <ETX>, <CKS>,<CR> (*)<br>reception not correct :<br><NAK>,<CR> (*)</td></tr>
</table>

| FUNCTIONS | To read | To write | Answer |
|---|---|---|---|
| **P-xx Parameters** | **...,<STX>, P, x,x, <ETX>,...** | | command accepted : **<STX>, P, x,x,=,n,...,n, <ETX>, <CKS>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>** (*)<br>reception not correct : **<NAK>,<CR>** (*) |
| | | **..,<STX>, P, x,x,=,n,...,n, <ETX>,..** | command accepted : **<ACK>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>** (*) |
| **b-xx Parameters** | **...,<STX>, b, x,x, <ETX>,...** | **Note:**<br>**n** means the value (0 or 1) of the parameter | command accepted : **<STX>, b, x,x,=,n, <ETX>, <CKS>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>** (*) |
| | | **..,<STX>, b, x,x,=,n, <ETX>,..**<br>**Note:**<br>**n** means the value (0 or 1) of the parameter | command accepted : **<ACK>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>** (*) |
| **Reference (0,01Hz resolution)** | **...,<STX>, H, <ETX>,...** | | command accepted : **<STX>, H, =,n, <ETX>, <CKS>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>** (*) |
| | | **..,<STX>, H, =,n,...,n, <ETX>,..** | command accepted : **<ACK>,<CR>**(*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>**(*) |
| **Sxx Registers** | **...,<STX>, S, x,x, <ETX>,...** | **Note:**<br>**x,x** means a register or one bit of the register<br>**n** means the actual value of the register (0/255) or of the bit (0 / 1) | command accepted : **<STX>, S, x,x,=,n,...,n, <ETX>, <CKS>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>** (*) |
| | | **..,<STX>, S, x,x,=,n,...,n, <ETX>,..**<br>**Note:**<br>**x,x** means a register or one bit of the register<br>**n** means the value to be written on the register (0/255) or on the bit (0 / 1)<br>S08, S28, S38, S58 registers, are read only registers | command accepted : **<ACK>,<CR>** (*)<br>command not accepted : **<STX>, E, <ETX>, <CKS>,<CR>**<br>reception not correct : **<NAK>,<CR>** (*) |

| FUNCTIONS | To read | To write | Answer |
|---|---|---|---|
| **C-xx Controls** | | **..,<STX>, C, x,x, <ETX>,..** | command accepted : **<ACK>,<CR> (*)** command not accepted : **<STX>, E, <ETX>, <CKS>,<CR> (*)** reception not correct : **<NAK>,<CR> (*)** |

**Note:**
The C-04, C-05, C-06, controls are not available.
Setting **b-39=0** it is possible to execute, by serial line, the command indicated on the table below:

| CODE xx | ACTION PERFORMED |
|---|---|
| 10 | hardware reset |
| 11 | alarm reset |
| 12 | do a coast to stop |
| 13 | decelerate in ramp up to a stop |
| 14 | clockwise start |
| 15 | anticlockwise start |
| 16 | clockwise jog |
| 17 | anticlockwise jog |
| 18 | clockwise flying restart |
| 19 | anticlockwise flying restart |
| 20 | d. c. braking |

**Input - output management**

Through the serial line it is possible to enter into some 8 bit registers with wich manage the inputs and outputs. The access to the registers is by bit or byte : in bit mode the " nth " bit of a register is accessed by substitution of the " 8 ", in the register code, with the digit " n " , i.e.: S10 means the bit 0 of the register S18; S15 means the bit 5 always of the register S18.

| REGISTERS | CODE | DESCRIPTION (REGISTER CONTENTS) |
|---|---|---|
| **Input Registers** | **S08** | Map of the inputs from the terminal block contacts (read only mode) |
| | **S18** | Map of the inputs from serial line (read/write mode) |
| | **S28** | Map of the inputs that the inverter really sees (read only mode)**.** The contents of **S28** derive from: **S28 = (S08 AND NOT(P-65)) OR (S18 AND P-65)** |
| **Output Registers** | **S38** | Map of the programmed outputs (read only mode) |
| | **S48** | Map of the outputs programmed by serial line (read/write mode) |
| | **S58** | Map of the outputs that the inverter really produces (read only mode). The contents of **S58** derive from: **S58 = (S38 AND NOT(P-66)) OR (S48 AND P-66)** |

| BIT NUMBER | CORRESPONDING INPUT | CORRESPONDING OUTPUT |
|---|---|---|
| **0** | IN4 | FAULT |
| **1** | IN3 | OUT3 |
| **2** | IN2 | OUT2 |
| **3** | IN1 | OUT1 |
| **4** | IN5 | - |
| **5** | INFLT | - |
| **6** | INRUN | - |
| **7** | INREV | - |

| PARAMETERS | DESCRIPTION |
|---|---|
| **b-39=0** | Terminal block controls are disabled; the management is through serial line only.<br>**P-65=0:** that input is not considered;<br>**P-65>0:** that input is sensed by the inverter<br>**P-66=0:** that output is managed by the program;<br>**P-66>0:** that output is managed by the serial line; |
| **b-39=1** | Terminal block controls are enabled; the management is either through serial line or contacts wired to the control terminal block .<br>**P-65=0:** that input come from the terminal block connections;<br>**P-65>0:** that input come from the serial line;<br>**P-66=0:** that output is managed by the program;<br>**P-66>0:** that output is managed by the serial line; |

The decimal value to be inserted in P-65 and P-66 represent the equivalent of the binary code that result when the bits of the parameters are set to "0" or "1" depending on the management of inputs and outputs.
i.e. if P-65 = 01000000(b), (64d), and b-39=1, the input INRUN is controlled via serial line, whereas all other inputs come from the control block terminal as programmed.

The MODBUS protocol defines the format and the communication modes between a system controlling "master" and one or more "slaves" aimed at answering to the master requests. The protocol states how the master and the slaves start and stop their communication, how the messages can be exchanged and how the errors can be detected. A common line can host one master and 247 slaves; this is a protocol logic limit, the device number can be further limited by the physical interface; the present implementation foresees a maximum number of 32 slaves to be line-connected.
A transaction can be started exclusively by the master. A transaction can have a direct demand/response format or a broadcast format. The former is addressed to a single slave, the latter to all the line slaves, which, on their turn, give no response. A transaction can have a single demand/single response frame or a single broadcast message/no response frame.
Some protocol features have not been defined. They are: interface standard, baud rate, parity, stop bit number. The protocol allows also to choose between two communication "modes": ASCII and RTU (Remote Terminal Unit). The RTU mode, which is the most efficient, is implemented in the Drives.
The JBUS protocol is similar to the MODBUS protocol; the only difference is given by the address numbering system: in MODBUS the numbering system starts from zero (0000 = 1st address) while in JBUS it starts from one (0001 = 1st address); this variance is maintained throughout the whole system. The following descriptions, if not otherwise stated, refer to both protocols.

**Message format**

In order to communicate between the two devices, the message has to be contained into a "casing". The casing leaves the transmitter via a "port" and it is "brought" along the line to a similar "port" on the receiver. MODBUS states the format of the casing, which, both for the master and for the slave, contains:
- The slave address for the master stated transaction (the address 0 corresponds to a broadcast message sent to all the slaves).
- The code of the function (already performed or to be performed).
- The data to be exchanged.
- The error control according to the CRC16 algorithm.

If a slave detects an error in the received message (a format, parity or CRC16 error), the message is invalid and therefore rejected; when a slave detects an error in the message, it does not perform the required action and does not answer to the demand as if the address does not correspond to an on-line slave.
Below is listed a description of Modbus messages format.

| ADDR | FUNC | DATA 1 | | DATA n | CRC HI | CRC LO |
|---|---|---|---|---|---|---|
| 8bit | 8bit | 8bit | | 8bit | 8bit | 8bit |

**The address**

As stated above, the MODBUS transactions always involve the master (which controls the line) and one slave at the time (with the exception of broadcast messages). In order to detect the message receiver, the first sent character is a byte containing the numeric address of the selected slave. Each slave owns therefore a different address number for its identification. The legal addresses go from 1 to 247, while a master message starting with the address 0 means that this is a "broadcast" message simultaneously addressed to all the slaves (the address 0 can not be allocated to a slave). Broadcast messages are those messages which do not need a response to perform their function, i.e. the allocations.

**The function code**

The second character of the message states the function to be performed by the master message; the slave response contains the same code, thus stating that the function has been performed.
An implemented subset of the MODBUS functions contains:
- 01 Read Coil Status
- 02 Read Input Status
- 03 Read Holding Registers
- 04 Read Input registers
- 05 Force Single Coil
- 06 Preset Single register
- 07 Read Status
- 15 Force multiple Coils
- 16 Preset Multiple Registers

The 01 and 02 functions, so as the 03 and 04 functions, are similar and interchangeable.

**CRC16**

The last two characters of the message contain the cyclic redundancy code (Cyclic Redundancy Check) calculated according to the CRC16 algorithm.

**Message synchronization**

The message synchronization between the transmitter and the receiver is obtained by interposing a pause between the messages, such pause being equal to 3.5 times the character period. If the receiver does not receive for a period equal to 4 characters, the message is considered to be over; as a consequence the following received byte is treated as the first byte of a new message: an address.

**Serial line setting**

The communication foresees the following settings:
- 1 start bit
- 8 data bits (RTU protocol)
- 1 stop bit
- no parity

The baud rate can be selected among the following values:

| Baudrate **byte** | Timeout **byte (ms)** |
|---|---|
| 1200 | 33 |
| 2400 | 16 |
| 4800 | 8 |
| 9600 | 4 |
| 19200 | 2 |

**Coils an Registers enumeration**

The inverter parameters have been organised to compose the registers list of Modbus inputs/outputs.
The parameters of "d" , "F", "P", "H" menus are considered as Registers.
The parameters of "B", "C" , "S" menus are considered as Coils.

*Register*

| Parameter drive type | Register Modbus |
|---|---|
| d00 .. d36 value at 16 bit | 1000 .. 1036 |
| d00 .. d36 value at 32 bit | 2000 .. 2072 |
| F00 .. F08 | 3000 .. 3008 |
| P00 .. P117 | 5000 .. 5117 |
| H00 | 7000 |

*Coil*

| Parameter drive type | Coil Modbus |
|---|---|
| b00 .. b69 | 1000 .. 1069 |
| c00 .. c20 | 2000 .. 2020 |
| S00 .. S58 | 3000 .. 3058 |

I valori a 32 bit sono accessibili tramite due registri a 16 bit contigui in cui i 16 bit meno significativi sono contenuti nel registro ad indirizzo inferiore. La coppia di registri deve essere letta (scritta) con un solo messaggio.

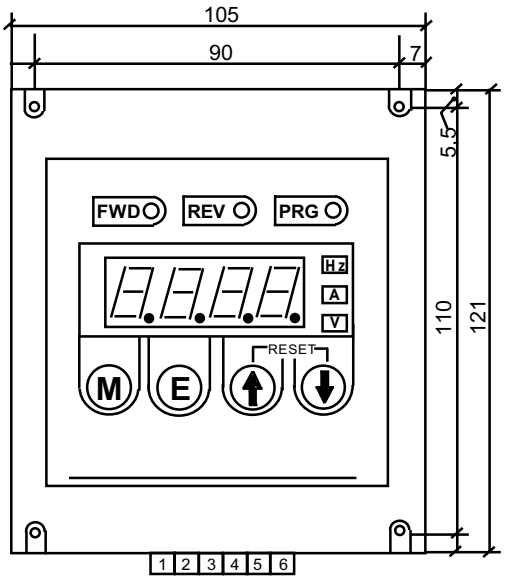
**Exception codes**

This protocol implementation foresees only four exception codes:

| Code | Name | Meaning |
|---|---|---|
| 01 | ILLEGAL FUNCTION | The received function code does not correspond to a function allowed on the addressed slave. |
| 02 | ILLEGAL DATA ADDRESS | The address number, which the data field refers to, is not a register allowed on the addressed slave. |
| 03 | ILLEGAL DATA VALUE | The value to be allocated, which the data field refers to, is not allowed for this register. |
| 07 | NAK - NEGATIVE ACKNOWLEDGEMENT | The function can not be performed with the present operating conditions or attempt to write an only-reading parameter. |

**The values at 32 bits are accessible through two registers at 16 bits; less minimful 16 bits are contained in the low address of the register. The two registers must be read/write with a single message.**
**For more information to the message formats, make reference the specific documentation or directly to the MODBUS standard.**

***AUXILIARY KEYBOARD* [ code AUX-TST ]**



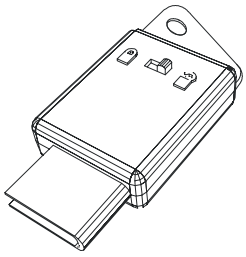

The auxiliary keyboard take the place of the on board keyboard when, for mounting reasons, it is not possible to reach the control panel.
It performs the same functions as the control panel.
As in the control panel, there are:
- 4 keys: **E**nter, **M**enù, ⇑, ⇓ (simultaneously pres ⇑ and ⇓ to reset the alarm )
- 4 7-segment digit to displays all parameters.
- 3 Led indicating: forward run, backward run, storage status.
- further 3 Led to indicate the units of parameter value displayed.

The auxiliary keyboard is equipped with a 6-wire extension cable, 2 m. long. This cable must be connected : one side to the connector on the control board to the left of control circuit terminals, the other side to the connector on the front, lower side, of the auxiliary keyboard. **Anything else is required to operate the auxiliary keyboard.**

***ENCODER* Optional Board [ code FOX-ENC ]**

The board is necessary to use an Encoder with the inverter. This little board is connected, under the cover, on the left side of the keypad panel through two mini-connectors; it is not possible to reverse the placement; the two microswitches must be directed towards the control terminal block. When ordering the inverter it is possible state the intention to use the encoder: in this case the Encoder Board will be factory connected; otherwise it is possible order the Encoder Board when needed but is mandatory that the mounting operation must be done by skilled personnel only, aware of electronic installation rules.

***PROGRAMMING KEY* [ code KM-PRG ]**



The programming key device allows for transferring parameters from and to the FOX inverter or between inverters.
The data are stored in a $E^2$PROM type memory, so battery backup is not necessary.
The switch put on upper front of the key allows to write protect the stored data.
To copy data from an inverter to the key or viceversa the keypad panel are used.

***PROGRAMMING KEY: use method***

***- Parameter transmission from the key to the inverter:***

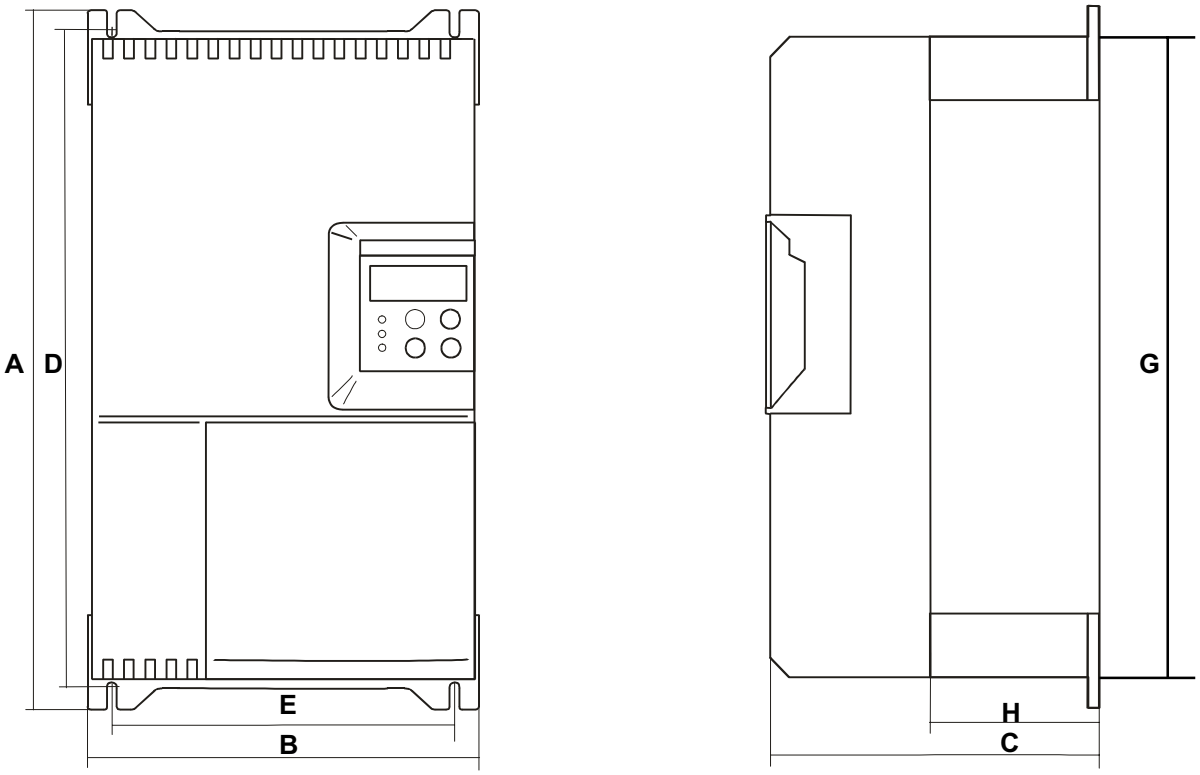
- plug the key in the appropriate hole on the upper left hand side of the inverter keypad panel
- select the parameter **C - 04,** go to the code **7** press **E.**

If the key contains invalid parameters, the factory-preset parameters will be used and the message "Err" will be displayed for 4 sec. Otherwise, data will be permanently stored and the confirmation message "donE" will be displayed for 2 sec.

***- Parameter transmission from the inverter to the board:***

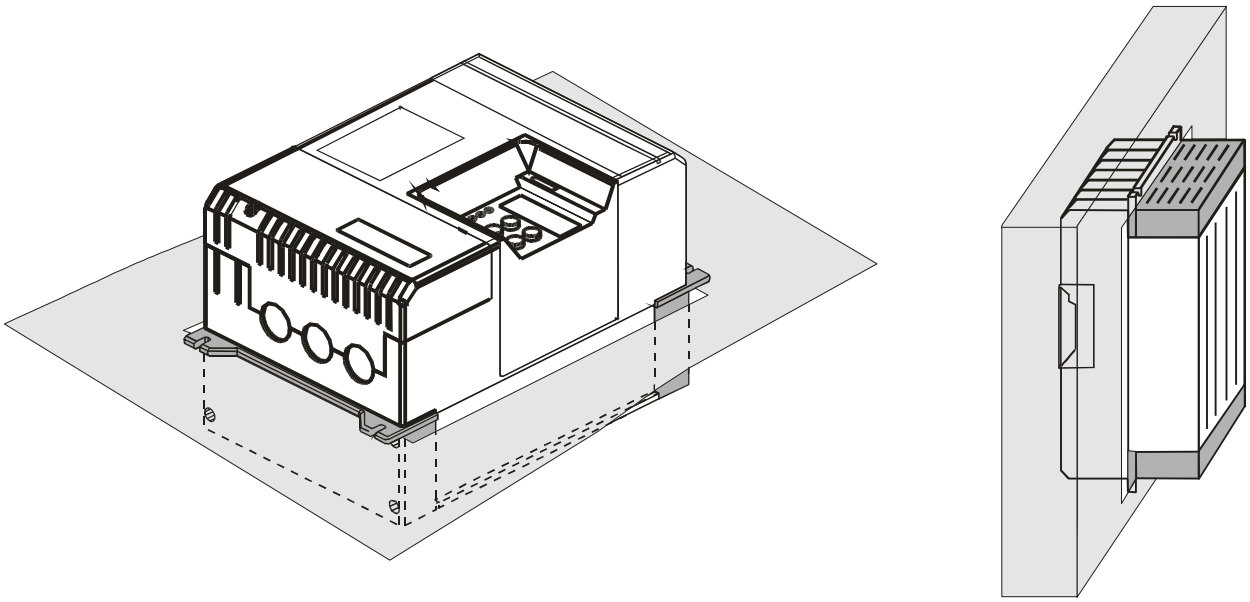
- plug the key in the appropriate hole on the upper left hand side of the inverter keypad panel
- select the parameter **C - 05,** go to the code **7** press **E.**

If the key is write-protected, the control is interrupted and the message " oFF" is displayed for 4 sec. Otherwise, the inverter parameters are stored on the key and, at the end of the operation, the message "donE" will be displayed for 2 sec. to confirm the operation.




| | Dimensions (mm) | | | | | | |
|---|---|---|---|---|---|---|---|
| **MODEL** | **A** | **B** | **C** | **D** | **E** | **H** | **G** |
| **SIZE 1** | **203** | **141** | **124** | **192** | **121** | **37** | **180** |
| **SIZE 2** | **269** | **170** | **163** | **253** | **147** | **68** | **240** |
| **SIZE 3** | **363** | **206** | **172** | **351** | **181** | **87** | **334** |

***SIZE 2 MODELS CAN BE MOUNTED THROUGH A HOLE ON A PANEL WHEN THE FIXING SOPPORTS ARE ROTATED UPSIDE-DOWN AS INDICATED BY THE FOLLOWING PICTURES:***



# EMC DIRECTIVE

## The possible Validity Fields of the EMC Directive (89/336) applied to PDS

"**CE marking**" summarises the presumption of compliance with the
Essential Requirements of the EMC Directive, which is formulated in the **EC Declaration of Conformity**
Clauses numbers [.] refer to European Commission document "Guide to the Application of Directive 89/336/EEC"
1997 edition. ISBN 92-828-0762-2

| | Validity Field | Description |
|---|---|---|
| Relates to PDS or CDM or BDM directly | **-1-**<br>**Finished Product/**<br>**Complex component**<br>available to general public<br>[Clauses: 3.7, 6.2.1, 6.2.3.1 & 6.3.1]<br><br>A PDS (or CDM/BDM) of the Unrestricted Distribution class | Placed on the market as a single commercial unit for distribution and final use.<br>Free movement based on compliance with the EMC Directive<br>- **EC Declaration of conformity required - CE marking required**<br>- **PDS or CDM/BDM should comply with IEC 1800-3/EN 61800-3**<br>The manufacturer of the PDS (or CDM/BDM) is responsible for the EMC behaviour of the PDS (or CDM/BDM), under specified conditions. EMC measures outside the item are described in an easy to understand fashion and could actually be implemented by a layman in the field of EMC.<br>The EMC responsiblity of the assembler of the final product is to follow the manufacturer's recommendations and guidelines.<br>Note: The manufacturer of the PDS (or CDM/BDM) is not responsible for the resulting behaviour of any system or installation which includes the PDS, see Validity Fields 3 or 4. |
| | **-2-**<br>**Finished Product/**<br>**Complex component**<br>only for professional assemblers<br>[Clauses: 3.7, 6.2.1, 6.2.3.2 & 6.3.2]<br>A PDS (or CDM/BDM) of the Restricted Distribution class sold to be included as part of a system or installation | Not placed on the marked as a single commercial unit for distribution and final use.<br>Intended only for professional assemblers who have a level of technical competence to correctly install.<br>- **No EC Declaration of conformity - No CE marking**<br>- **PDS or CDM/BDM should comply with IEC 1800-3/EN 61800-3**<br>The manufacturer of the PDS (or CDM/BDM) is responsible for the provision of installation guidelines that will assist the manufacturer of the apparatus, system or installation to achieve compliance.<br>The resulting EMC behaviour is the responsibility of the manufacturer of the apparatus, system, or installation, for which its own standards may apply. |
| Relates to application of PDS or CDM or BDM | **-3-**<br>**Installation**<br>[Clause: 6.5]<br>Several combined items of system, finished product or other components brought together at a given place. May include PDSs (CDM or BDM), possibly of different classes - Restricted or Unrestricted | Not intended to be placed on the market as a single functional unit (no free movement). Each system included is subject to the provisions of the EMC Directive.<br>- **No EC Declaration of conformity - No CE marking**<br>- **For the PDSs or CDM/BDMs themselves see Validity Fields 1 or 2**<br>**- Responsibility of the manufacturer of the PDS may include commissioning**<br>The resulting EMC behaviour is the responsibility of the manufacturer of the installation in co-operation with the user (e.g. by following an appropriate EMC plan). Essential protection requirements of EMC Directive apply regarding the neighbourhood of the installation. |
| | **-4-**<br>**System**<br>[Clause: 6.4]<br><br>Ready to use finished item(s). May include PDSs (CDM or BDM), possibly of different classes - Restricted or Unrestricted | Has a direct function for the final user. Placed on the market for distribution as a single functional unit, or as units intended to be easily connected together.<br>- **EC Declaration of conformity required - CE marking required for the system**<br>- **For the PDSs or CDM/BDMs themselves see Validity Fields 1 or 2**<br>The resulting EMC behaviour, under specified conditions is the responsibility of the manufacturer of the system by using a modular or system approach as appropriate.<br>Note: The manufacturer of the system is not responsible for the resulting behaviour of any installation which includes the PDS, see Validity Field 3. |

## Examples of application in the different Validity Fields:

1 **BDM to be used anywhere:** (example in domestic premises, or BDM available from commercial distributors), sold without any knowledge of the purchaser or the application. The manufacture is responsible that sufficient EMC can be achieved even by any unknown customer or layman (snap-in, switch-on).

2 **CDM/BDM or PDS for general purpose:** to be incorporated in a machine or for industrial application This is sold as a subassembly to a professional assembler who incorporates it in a machine, system or installation. Conditions of use are specified in the manufacturer's documentation. Exchange of technical data allows optimisation of the EMC solution.. (See restricted distribution definition).

3 **Installation:** It can consist of different commercial units (PDS, mechanics, process control etc.). The conditions of incorporation for the PDS (CDM or BDM) are specified at the time of the order, consequently an exchange of technical data between supplier and client is possible. The combination of the various items in the installation should be considered in order to ensure EMC. Harmonic compensation is an evident example of this, for both technical and economical reasons. (E.g. rolling mill, paper machine, crane, etc.)

4 **System:** Ready to use finished item which includes one or more PDSs (or CDMs/BDMs); e.g. household equipment, air conditioners, standard machine tools, standard pumping systems, etc.

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# DECLARATION OF CONFORMITY

Sirco Automazione s.r.l.

Via dell'Artigianato 37, 30030 Vigonovo (VE) - Italia

AS MANUFACTURER

## DECLARE

UNDER OUR SOLE RESPONSABILITY THAT THE PRODUCT:

| | |
|---|---|
| MAKE | **FOXM** (sinusoidal PWM digital AC drives for regulating the speed of induction motors) |
| TYPE | **FOXM2M004....022, FOXM2T004....022, FOXM4T004....150.** |

TO WHICH THIS DECLARATION RELATES, APPLIED UNDER CONDITIONS SUPPLIED IN THE USER'S MANUAL, CONFORMS TO THE FOLLOWING STANDARDS OR NORMATIVE DOCUMENTS:

| | |
|---|---|
| prEN61800-3 | EMC product standard including specific test methods for power drive system. |
| EN50081-1 | Electromagnetic compatibility - Generic standards for conducted and radiated emission: residential, commercial and light industry (class B). |
| EN50081-2 | Electromagnetic compatibility - Generic standards for conducted and radiated emission: industrial environment (class A). |
| EN55011 | Limits and methods of measurements of electromagnetic disturbance characteristics of industrial scientific and medical (ISM) radiofrequency equipment. |
| EN61000-4-2 | Electromagnetic compatibility - Part 4:Testing and measurement techniques<br>Sezione 2: Electrostatic discharge immunity test. |
| EN61000-4-4 | Electromagnetic compatibility - Part 4:Testing and measurement techniques<br>Sezione 4: Electrical fast transient/burst immunity test. |
| EN61000-4-8 | Electromagnetic compatibility - Part 4:Testing and measurement techniques<br>Section 8: Power frequency magnetic field immunity test. Basic EMC publication. |
| ENV50140 | Electromagnetic compatibility - Basic immunity standard<br>Radiated, radio-frequency electromagnetic field - Immunity test. |

FOLLOWING THE PROVISIONS OF ELECTROMAGNETIC COMPATIBILITY DIRECTIVE 89/336/EU AND SUBSEQUENT AMENDMENTS 92/31/EU AND 93/68/EU.

PLACE AND DATE OF ISSUE
Vigonovo , 04/12/2002

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